1998-2005 ENGINE

Engine timing - 163 Chassis

GENERAL INFORMATION

GENERAL NOTES: PASSENGER CARS: ENGINE TIMING - AH05.00-Z-9999AZ

MODEL all

	Loosening and tightening regulation for camshaft bearing caps	ENGINE 160.921 /922 /923 in MODEL 452.3/4	AH05.20-P-0300-01RR
	Loosening and tightening regulation for camshaft bearing caps	ENGINE 160, 660...	AH05.20-P-0300-01SM
	Note concerning adjusting the valve seat cutter	ENGINE 160 in MODEL 450.3/4, 452.3/4	AH05.30-P-4520-01A
	Note concerning valve seat machining	ENGINE 160 in MODEL 450.3/4, 452.3/4	AH05.30-P-4520-02A
	Information on application of sealant to bottom part of camshaft housing	ENGINE 271	AH05.20-P-6995-01QK
	General notes on timing, markings	ENGINE 112, 113, 112.951/976	**AH05.10-P-1000-01A**
	Camshaft code number and assignment	ENGINE 111.948 /978, 112, 113	**AH05.20-N-0100-01A**
	Camshaft code number and assignment	ENGINE 111	AH05.20-P-0100-01AG
	Camshaft code number and assignment	ENGINE 120	AH05.20-P-0100-01AO
	Slackening and tightening instructions for the camshaft bearing caps	ENGINE 275	AH05.20-P-0300-01A
	Marking of camshaft bearing caps	ENGINE 266.920 /940 /960 /980	AH05.20-P-6992-01AK
	Marking of camshaft bearing caps	ENGINE 120	AH05.20-P-6992-01AO
	Camshaft, code numbers and allocation	ENGINE 601, 602, 603	AH05.20-P-6992-03HB
	Notes on the application of sealing compound of the camshaft case	ENGINE 266.980 in MODEL 169.0 /3, 245.2	AH05.20-P-6995-02BK
	Marking of camshaft bearing caps	ENGINE 668.914 /940 /941 /942	AH05.20-P-6992-01GD
	Marking on camshaft bearing caps	ENGINE 611, 646.8 /951 /961 /962 /963 /966	AH05.20-P-6992-04HB
	Marking of camshaft bearing caps	ENGINE 613, 648	AH05.20-P-6992-04HD
	Loosening and tightening regulation for	ENGINE 601.943,	AH05.20-N-

	camshaft bearing caps	602.980 /983 /981 /984 /985, 601.942 /970	0300-01B
	Identification of camshaft bearing caps	ENGINE 111 /948 /978	AH05.20-N-6992-01A
	Notes on installing camshaft bearing bridge	ENGINE 112, 113...	**AH05.20-P-2000-01AV**
	Notes on installing camshaft bearing bridge	ENGINE 113.960 with CODE (479) Cylinder shutoff	AH05.20-P-2000-01BV
	Notes on coupling rocker arm	ENGINE 113.960 with CODE (479) Cylinder shutoff	AH05.20-P-3000-01AV
	Marking of camshaft bearing caps	ENGINE 166	AH05.20-P-6992-01GF
	Marking of camshaft bearing caps	ENGINE 612 /965 /966, 647.961	AH05.20-P-6992-04HC
	Marking of camshaft bearing caps	ENGINE 628, 629 ...	AH05.20-P-6992-04HE

GENERAL NOTES ON TIMING, MARKINGS - AH05.10-P-1000-01A

Engine 112, 113

Shown on engine 112

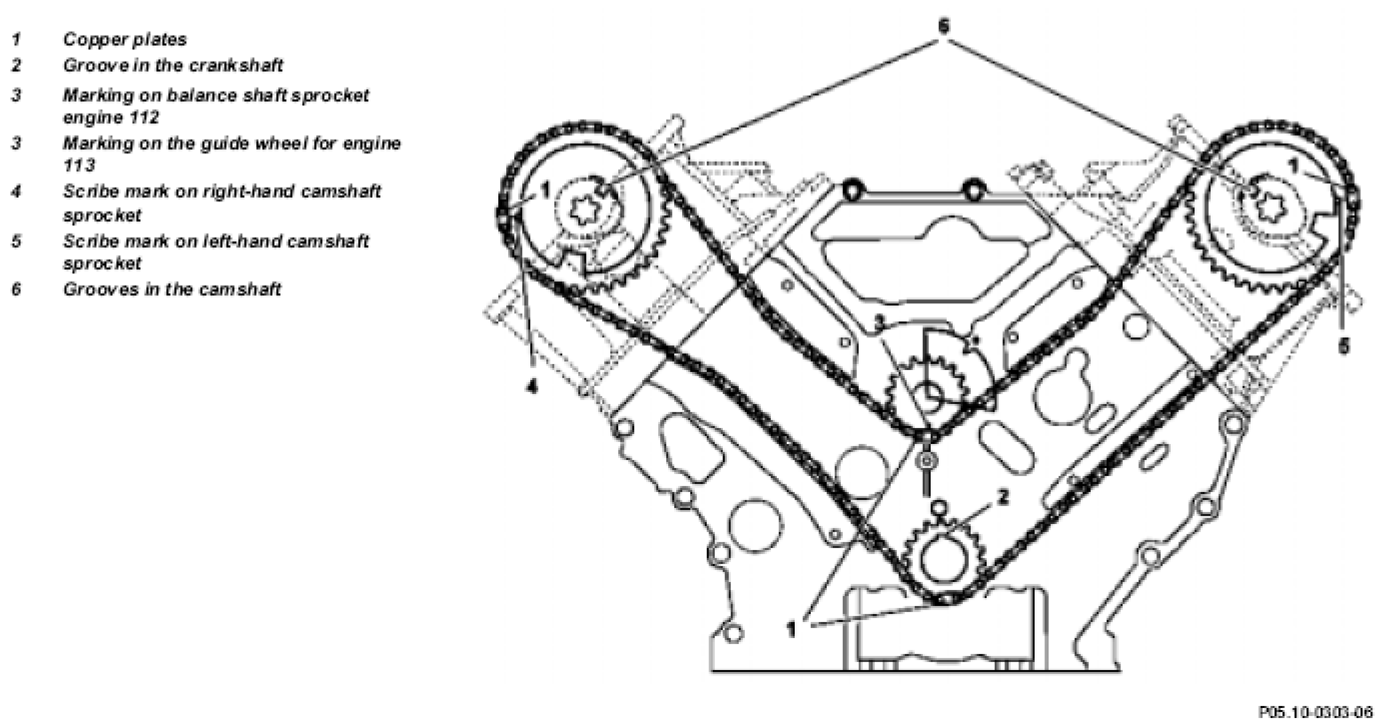


Fig. 1: Identifying Timing, Markings - Shown On Engine 112

The four copper plates for the timing chain facilitate assembly when putting on timing chain. Every copper

plate (1) must coincide with one of the markings.

Due to unequal length of timing chain paths, the engine must be cranked up to 14 times until the copper plates are matched again with the markings.

CAMSHAFT CODE NUMBER AND ASSIGNMENT - AH05.20-N-0100-01A

Engine 111, 112, 113

Inspection data of camshaft code numbers

Number	Designation		Engine 111.948	Engine 111.978
BE05.20-N-1001-01A	Camshaft code numbers	Intake	16	16
		Exhaust	24	17
BE05.20-N-1002-01A	Camshaft code numbers repair camshaft	Intake	19	19
		Exhaust	25	20

Inspection data for camshaft code numbers

Number	Designation	Engines 113.940// 941/942943	Engine 113.944	Engine 113.960 with code 479	Engine 113.960 without Code 479
BE05.20-P-1001-01G	Left camshaft code number	04/28/34/52	41	32	06/10/29/36/54
BE05.20-P-1002-01G	Right camshaft code number	05/30/35/53	40	33	07/11/31/37/55

Inspection data for camshaft code numbers

Number	Designation	Engines 113.961/962/963	Engines 113.980/981/984	Engine 113.987/988/989/990/991
BE05.20-P-1001-01G	Left camshaft code number	06/10/29/36/54	39	61
BE05.20-P-1002-01G	Right camshaft code number	07/11/31/37/55	38	60

Engine 112, 113

The camshaft code number is located at the flange for the camshaft sprockets (arrow).

Shown on camshaft for engine 112.

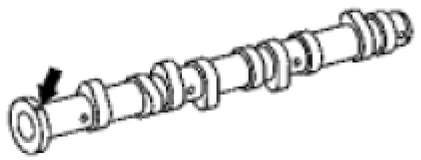


Fig. 2: Locating Camshaft Code Number - Shown On Camshaft For Engine 112

NOTES ON INSTALLING CAMSHAFT BEARING BRIDGE - AH05.20-P-2000-01AV

Engines 112, 113 except 113.960, 113.960 except cylinder shutoff codes 479, 113.962/982/993, 112.951/976

Pay attention to the following notes before installing the camshaft bearing bridges:

- Lubricate the camshaft bearings.
- Due to tolerance reasons, the camshafts must not be replaced individually.
- If the camshaft bearing bridge is damaged, replace the cylinder head complete with the camshaft bearing bridge.
- It not permitted to reuse the bolts M7X84; these must always be replaced.
- Pay attention to tightening torque, slackening diagram and tightening diagram of the bolts M7x84.

Shown on engine 112

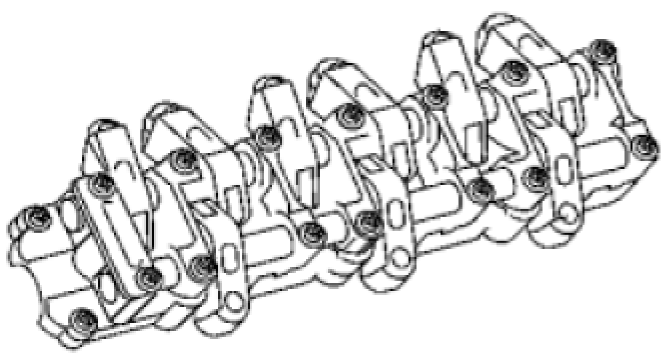


Fig. 3: Identifying Camshaft Bearings Bridge Bolts

BASIC KNOWLEDGE

DESIGN OF CHAIN TENSIONER - GF05.10-P-7801-01A

Engines 112, 113

Shown on engine 112



Fig. 4: Identifying Design Of Chain Tensioner - Engines 112, 113

TIMING CHAIN DRIVE, GENERAL - GF05.10-P-9611-01C

Engine 112, 113

Shown on engine 112

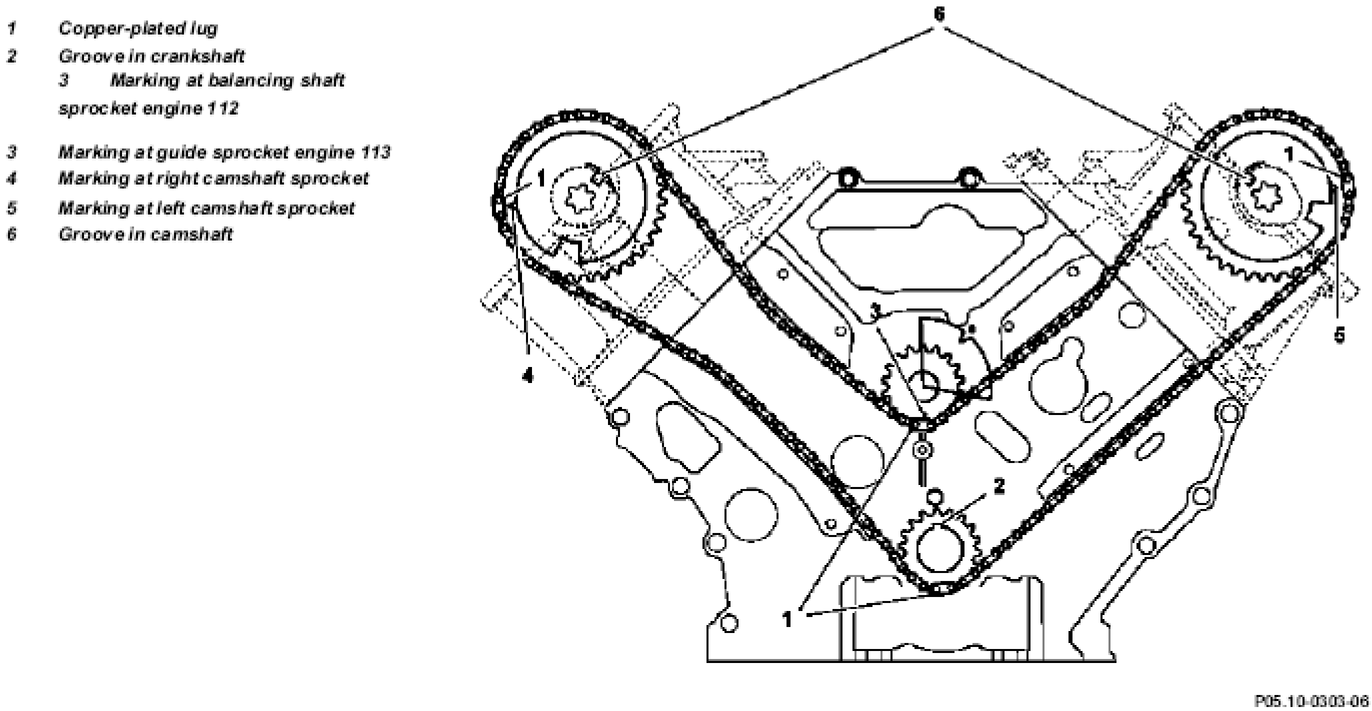


Fig. 5: Identifying Timing, Markings - Shown On Engine 112

Engine timing

The basic setting is 40° after TDC.

At 40° after TDC the grooves (6) in the left and right camshafts point in the direction of the inner V and are centered on the parting surface of the cylinder head cover. The copper-plated lugs (1) and marks on the camshaft sprockets (4 and 5) coincide.

The groove in the crankshaft (2) and the mark on the balance shaft sprocket (3) point toward one anther and both coincide with the copper-plated lugs (1).

Rubber-coated sprockets

In order to improve the noise characteristic of the timing case drive the chain sprockets on the crankshaft, balance shaft and camshafts are rubber-coated.

Only on engine 112

6 mm dia. locating holes (a) are located coinciding with one anther in the rear balancing weight on the balance shaft and rear of the crankcase.

Repair note

Due to the difference in the timing chain paths it may be necessary to crank the engine up to 14 times before the

marks on the camshafts coincide again.

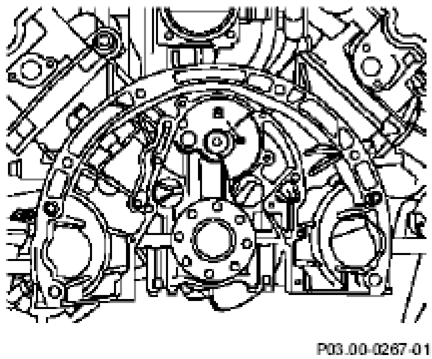


Fig. 6: Identifying Holes - Only On Engine 112

Only on engine 112

Checking the balance shaft with engine assembled

Two marks, one at the front of the crankcase and the other on the end of the balancing weight, point toward one anther and can be seen through the left timing case shaft approx. 22 cm. below the parting surface of the cylinder head cover when the cylinder head cover is removed.

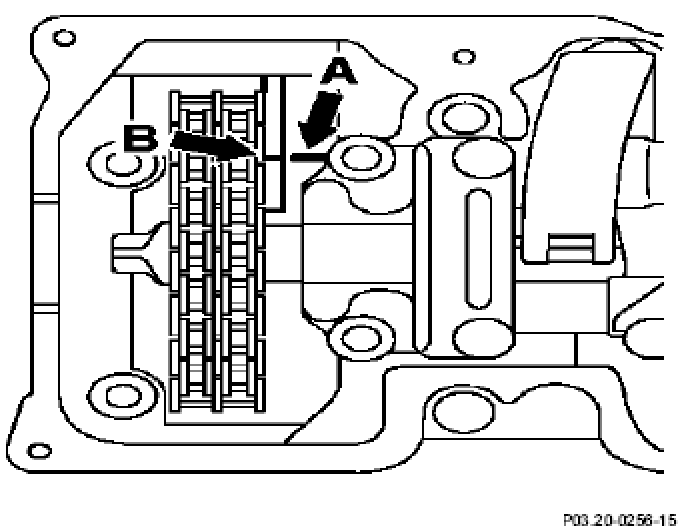


Fig. 7: Identifying Two Marks On Front Of Crankcase

SAFETY PRECAUTIONS

SAFETY INFORMATION: ENGINE TIMING - AS05.00-Z-9999ZZ

MODEL all

Nm	Risk of explosion and poisoning caused by the melting down or improper handling of sodium-filled valves. Risk of injury caused by skin contact with sodium resulting in heat or chemical burns.	ENGINE 111, 112, 113, 137, 155, 156, 166, 266, 646, 647, 648 ...	**AS05.30-Z-0001-01A**

RISK OF EXPLOSION AND POISONING - AS05.30-Z-0001-01A

Do not open sodium-filled valves. Wear protective gloves and safety glasses when handling damaged valves.

Exhaust valves filled with sodium

Potential risks

Risk of explosion

Explosion may occur when melting down sodium-filled valves. Sodium has a very low self-ignition temperature (121 °C) and may spontaneously ignite in moist air.

Improper disposal may lead to fires due to moisture in scrap containers.

Risk of poisoning

The inhalation of toxic vapors causes severe irritation, shortness of breath, headaches, nausea and vomiting.

Risk of injury

Leaked sodium that comes into contact with moist body tissue (perspiration on hands, tears) may undergo a severe, explosive reaction and generate heat. This may lead to skin irritation and burns, and to corneal damage with possible blinding.

Safety instructions/precautions

- Keep water and sources of heat and ignition away from sodium.
- When handling damaged, sodium-filled valves, wear suitable protective gloves and safety glasses, if necessary.
- Never machine sodium-filled valves.
- Do not open sodium-filled valves.
- Observe all additional safety requirements and regulations in your country.

First aid measures

Skin and eye contact

- Remove sodium, treat the injured area with an oily solution, e.g. Biseptol and consult a physician.

Ingestion

- Do not give the affected person anything to drink, consult a physician.

Vapor inhalation

- Move the victim out of the risk area.
- If victim has the urge to vomit, give him/her oxygen.
- In the event of respiratory failure, administer artificial respiration and notify a physician.

TESTING & REPAIR

REMOVE/INSTALL HYDRAULIC VALVE CLEARANCE COMPENSATION ELEMENTS - AR05.00-P-2011B

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

ENGINE 112 in MODEL 129, 163, 170, 202, 203, 208, 209, 210, 220

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113 in MODEL 129, 163, 202, 203, 208, 209, 210, 215, 220, 230.474 /475

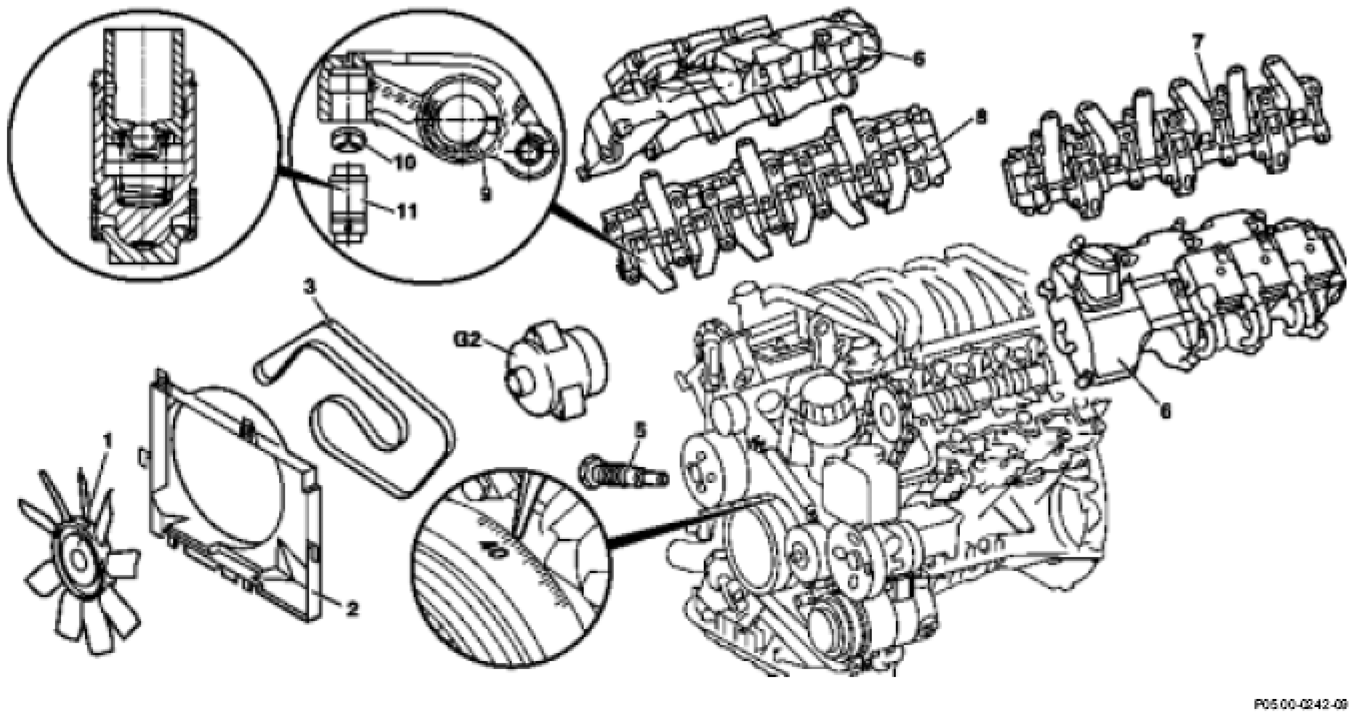
ENGINE 112.913 in MODEL 211.061/261

ENGINE 112.949 in MODEL 211.065/265

ENGINE 113.967 in MODEL 211.070/270

ENGINE 113.982 in MODEL 463.243/246

ENGINE 113.990 in MODEL 211.076/276



1	Viscous fan	5	Chain tensioner
2	Fan shroud	6	Cylinder head covers with ignition coils
3	Poly-V-belt	7	Left camshaft bearing bridge
		8	Right camshaft bearing bridge
9	Roller rocker arm	10	Disk
11	Compensating element	G2	Alternator

Fig. 8: Identifying Hydraulic Valve Clearance Compensation Element Components - Shown On Engine 112 In Model 210

Shown on engine 112 in model 210

i	**Remove/Install**		
1	Remove cylinder head covers with ignition coils (6)	Air cleaner mounted on vehicle. Air cleaner positioned at engine side.	**AR01.20-P-5014B** **AR01.20-P-5014BV**
2	Position crankshaft to 0° after ignition TDC of cylinder 1	The engine must not be turned back; otherwise the chain can get jammed.	**AR05.10-P-6858V**
		Model 129, 463.206/209/232/233/240/241/243/244/245/246/247/248/249/250/254, Model 163 except 163.174/175, Model 202, 208, 210 with engine 113 Model 163.174/175, Model 209 with engine 113.987 up to 23.4.04,	**AR05.10-P-7800C** **AR05.10-**

3	Remove chain tensioner (5)	Model 209 with engine 113.968 Model 170, 202, 203, 208, 209, 210 with Engine 112 Model 203 with engine 113.988 Model 209 with engine 113.987 as of 24.4.04 Model 211, 215, 220, 230	**P-7800CA** AR05.10-P-7800AC AR05.10-P-7800AM
4	Detach left camshaft bearing bridge (7) and right camshaft bearing bridge (8)	Engine 112, 113 except cylinder shutoff, code 479. Engine 113.960 with cylinder shutoff, code 479. **Installation:** Check basic position of camshafts, if required: ? Set the basic position of camshafts	**AR05.20-P-7103AU** AR05.20-P-7103AV **AR05.10-P-6858V** **AR05.20-P-6020AU**
5	Use a 2 mm drift to press compensation element (11) of the relevant cylinder out of the roller rocker arms (9)	Do not use a magnet! The slide surface of the compensation element (11) would get magnetized. This can cause minute iron chips to accumulate, which in turn can damage the compensation element (11) and the cam. **Installation:** The small plate at the top of the roller-type rocker arm must point to the compensation element with the slits facing downwards (11). Compensation elements which have not been replaced, must be reinstalled at the same point.	
6	Install in the reverse order		

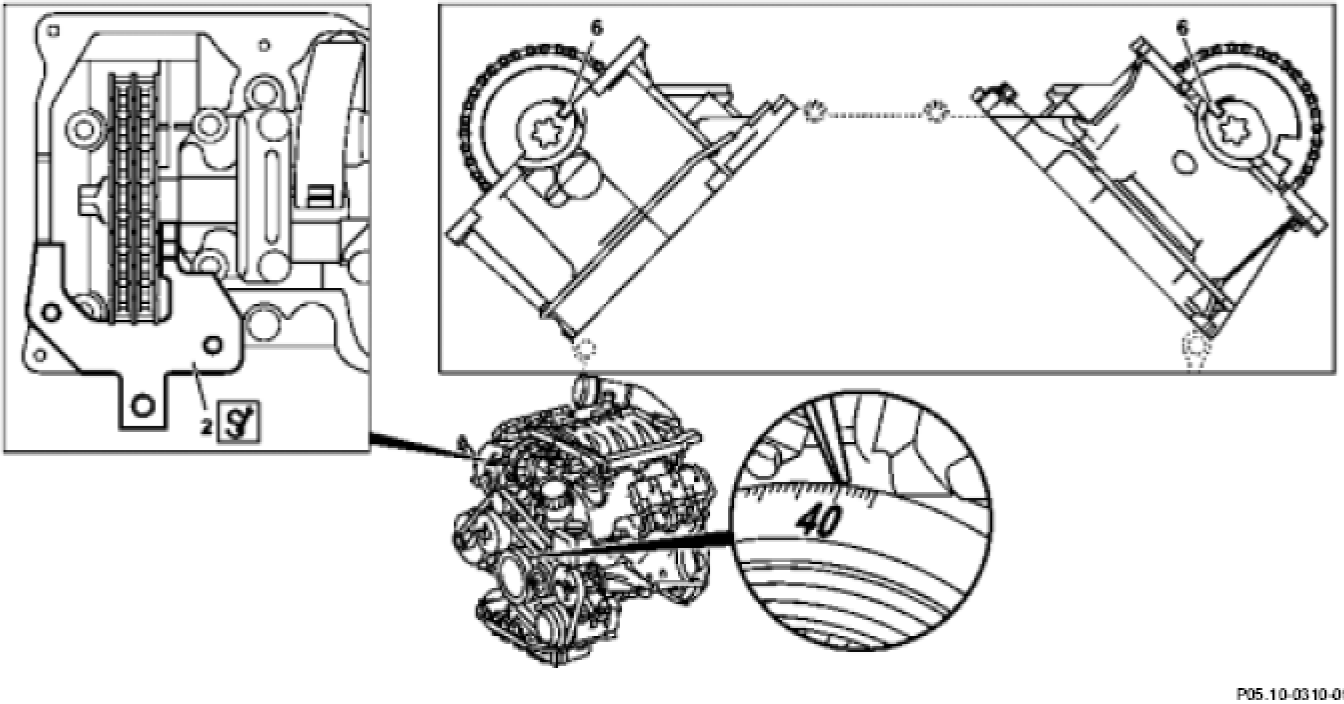
CHECK THE ENGINE VALVE TIMING - AR05.10-P-6858V

ENGINE 112

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243/246

ENGINE 113 (except 113.995) in MODEL 129, 163, 202, 203, 208, 209, 210, 211, 215, 220, 230



2 Locating plate for right camshaft 6 Slot in camshaft

A Pin on crankcase
B Notch in balancing weight

Fig. 9: Identifying Engine Valve Timing, Pin On Crankcase - Shown On Engine 112

Shown on engine 112

Inspect basic position of balancing shaft only engine 112

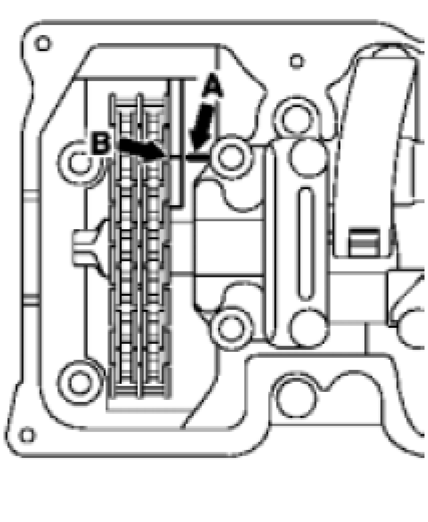


Fig. 10: Locating Notch In Balancing Weight, Pin On Crankcase

	Remove/install	
1	Remove cylinder head covers	Air filter located at vehicle side. Air filter located on engine side.
2.1	Unbolt combination valve (on right)	Only for engines with air pump. **Installation:** Replace Gasket of combination valve. AH
	Checking	
3	Inspect timing	Engine 112.910/911/912/920/921/922/923/940/941/942/942/944/945/946/947/949, Engine 113.940/941/942/943944/960//961/962/963/965/967/968/980/981/982/984/987/990/991/992 Engine 113.960 with cylinder shutoff code 479 see: ? Inlet Outlet
	Camshaft code number and assignment	Engine 112, 113
4	Position engine to 40° after ignition TDC of cylinder 1	Rotate engine at crankshaft in direction of rotation until 40° marking on belt pulley/vibration damper is aligned with marking on timing case cover. Slots at camshafts must be pointing in direction of inner V. The engine must not be turned back; otherwise the timing chain can get jammed.
5	Check basic position of camshafts	Place locating plate for right camshaft (2) flush onto the right cylinder head and insert into the groove in the camshaft (6). Proceed the same way with the left-hand camshaft in the left-hand cylinder head. If both locating plates cannot be inserted into the grooves: ? Set the basic position of camshafts.
6.1	Inspect basic position of the balancing shaft	Only for Engine 112, see figure. The markings of the pin at front crankcase (A) and the notch in the correctional weight (B) on the front end of the correctional weight point to each other. The two scribe marks can be seen through the left timing case duct at a depth of about 22 cm from the cylinder head cover joint surface.
7	Install in the	

	reverse order

Test values for timing

Number	Designation			Engines 112.910/911 left-hand	Engines 112.910/911 right-hand	Engines 112.910/913/920/921/922/923 on the left
BE05.20-P-1001-02F	Timing of inlet valve with 2 mm play and used timing chain	opens after TDC	°CA	24.9	26.5	26.9
		closes after BDC	°CA	20.2	21.8	23.2
BE05.20-P-1002-02F	Timing of exhaust valve with 2 mm play and used timing chain	opens before BDC	°CA	28.1	26.5	29.1
		opens after BDC	°CA	-	-	-
		closes before TDC	°CA	13.1	11.5	14.1

Test values for timing

Number	Designation			Engines 112.912/913/920/921/922/923 right	Engines 112.940/941/942/943/944/945/946/947/948/949/951 left
BE05.20-P-1001-02F	Timing of inlet valve with 2 mm play and used timing chain	opens after TDC	°CA	28.5	24.9
		closes after BDC	°CA	24.8	25.9
BE05.20-P-1002-02F	Timing of exhaust valve with 2 mm play and	opens before BDC	°CA	27.5	31.5
		opens after BDC	°CA	-	-

	used timing chain	closes before TDC	° CA	12.5	12.1

Test values for timing

Number	Designation			Engines 112.940/941/942/943/944/945/946/947/948/949/951/976 right	Engines 113.940/941/942/943 left
BE05.20-P-1001-02F	Timing of inlet valve with 2 mm play and used timing chain	opens after TDC	° CA	26.5	31.9
		closes after BDC	° CA	27.5	28.2
BE05.20-P-1002-02F	Timing of exhaust valve with 2 mm play and used timing chain	opens before BDC	° CA	29.9	24.1
		opens after BDC	° CA	-	-
		closes before TDC	° CA	10.5	9.1

Test values for timing

Number	Designation			Engines 113.940/941/942/943 on the right	Engine 113.940/94
BE05.20-P-1001-02F	Timing of inlet valve with 2 mm play and used timing chain	opens after TDC	°CA	33.5	26
		closes after BDC	°CA	29.8	34
BE05.20-P-1002-02F	Timing of exhaust valve with 2 mm play and used timing chain	opens before BDC	°CA	22.5	34
		opens after BDC	°CA	-	-
		closes before TDC	°CA	7.5	14

Test values for timing

Number	Designation			Engines 113.960/961/962/963/964/965/967/968/971 left	Engines 113.960/961/962/963/964/965/967/968 right
BE05.20-P-1001-02F	Timing of inlet valve with 2 mm play and used timing chain	opens after TDC	° CA	30.9	32.5
		closes after BDC	° CA	25.7	27.3
BE05.20-P-1002-02F	Timing of exhaust valve with 2 mm play and used timing chain	opens before BDC	° CA	23.2	21.6
		opens after BDC	° CA	-	-
		closes before TDC	° CA	9.1	7.5

Test values for timing

Number	Designation			Engines 113.987/988 989/990//991992/993/995 left and right
BE05.20-P-1001-02F	Timing of inlet valve with 2 mm play and used timing chain	opens after TDC	°CA	25.7
		closes after BDC	°CA	33.7
BE05.20-P-1002-02F	Timing of exhaust valve with 2 mm play and used timing chain	opens before BDC	°CA	31.5
		opens after BDC	°CA	-
		closes before TDC	°CA	11.3

Test values for timing

Number	Designation			Engine 113.960 with code 479 right	Engine 113.960 with code 479 left
BE05.20-P-	Timing of inlet	opens after TDC	°CA	36.9	28.5

1001-02F	valve with 2 mm play and used timing chain	closes after BDC	°CA	28.5	14.8
BE05.20-P-1002-02F	Timing of exhaust valve with 2 mm play and used timing chain	opens before BDC	°CA	24.3	27.5
		opens after BDC	°CA	-	-
		closes before TDC	°CA	14.1	12.5

AH Intake manifold

Number	Designation			Engines 112, 113
BA09.20-P-1001-01D	Bolt, intake manifold to cylinder head	M8	Nm	20

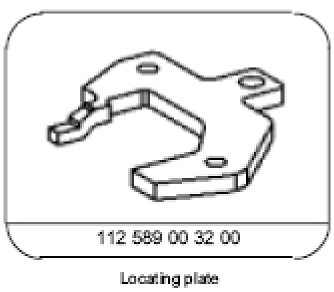


Fig. 11: Identifying Locating Plate (112 589 00 32 00)

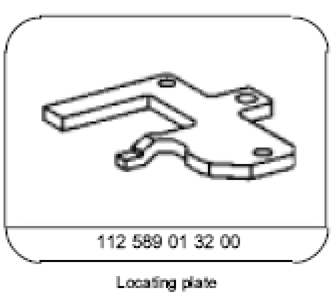


Fig. 12: Identifying Locating Plate (112 589 01 32 00)

SEPARATE TIMING CHAIN - AR05.10-P-7601-01AV

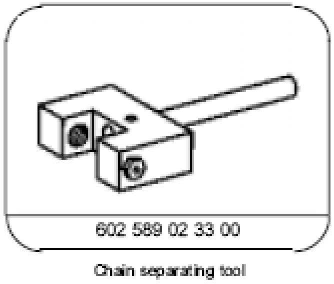


Fig. 13: Identifying Chain Separating Tool (602 589 02 33 00)

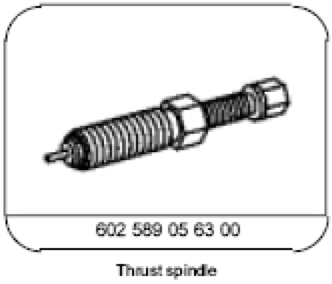


Fig. 14: Identifying Thrust Spindle (602 589 05 63 00)

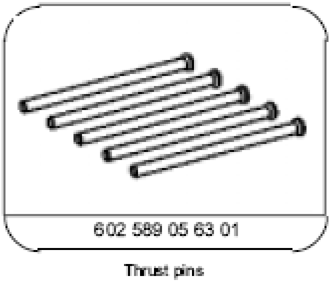


Fig. 15: Identifying Thrust Pins (602 589 05 63 01)



Fig. 16: Identifying Case (602 589 00 98 00)

1. ◁ Assemble chain separating tool (1) and ◁ thrust spindle (2).

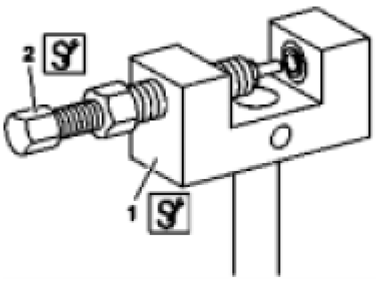


Fig. 17: Identifying Chain Separating Tool

2. Fit the chain separating tool (1) with the pressure screw (2) at the chain link to the right of the copper plate on the timing chain (4).

   See new timing chain.

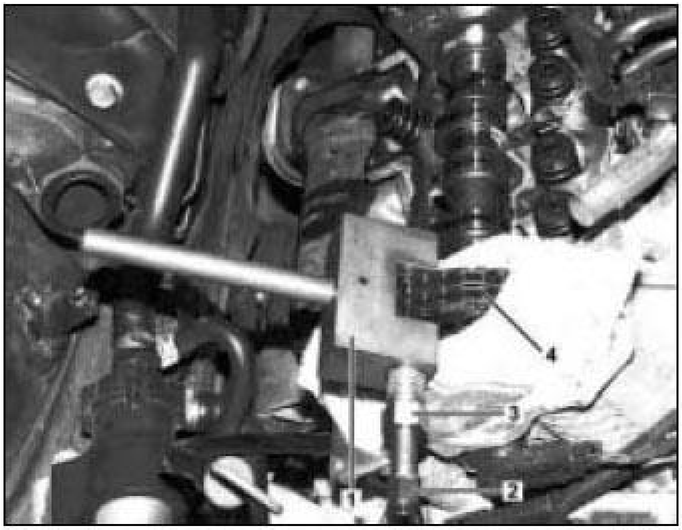
3. Screw in the guide sleeve (3) of the pressure screw (2) till it touches the chain link.

   Ensure that the guide sleeve (3) is located above the clinch bolt of the chain link.

4. Screw in the pressure screw (2) and separate the timing chain (4).
5. Remove the pressure screw (2).
6. Remove the chain separating tool (1)and fit it at the second clinch bolt.
7. Repeat steps 3, 4 and 5 at the second clinch bolt.

   Do not let the pushed out clinch bolts and plates to fall into the crankcase.

8. Remove the chain separating tool (1).



P05.10-2025-11

Fig. 18: Identifying Chain Separating Tool, Pressure Screw, Guide Sleeve And Timing Chain

RIVET TIMING CHAIN - AR05.10-P-7601-02AV

AH Camshaft

Number	Designation				Engine 112 except 112.951/976	Engine 112.951/976
BA05.20-P-1001-01B	Bolt for camshaft sprocket	M12x45	Stage 1	Nm	50	50
			Stage 2	Angle°	90	90

AH Camshaft

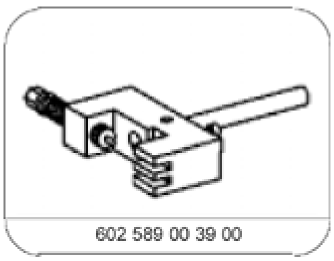
Number	Designation				Engines 113.940/941/942/943/944/948/961/962/963/964/965/966/967/968/969
BA05.20-P-1001-01B	Bolt for camshaft sprocket	M12x45	Stage 1	Nm	50
			Stage 2	Angle°	90

AH Camshaft

Number	Designation				Engine 113.960 without code 479	Engine 113.960 with code 479
BA05.20-P-1001-01B	Bolt for camshaft sprocket	M12x45	Stage 1	Nm	50	50
			Stage 2	Angle°	90	90

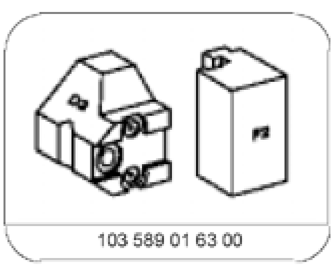
AH Camshaft

Number	Designation				Engine 113.987/988/990/993	Engine 113.987/9	Engine 113.987/988/1
BA05.20-P-1001-01B	Bolt for camshaft sprocket	M12x45	Stage 1	Nm	50	50	50
			Stage 2	Angle°	90	90	90



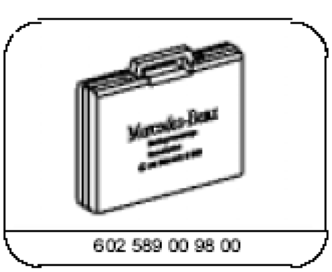
Riveting tool

Fig. 19: Identifying Riveting Tool (602 589 00 39 00)



Assembly inserts

Fig. 20: Identifying Assembly Inserts (103 589 01 63 00)



Case

Fig. 21: Identifying Case (602 589 00 98 00)

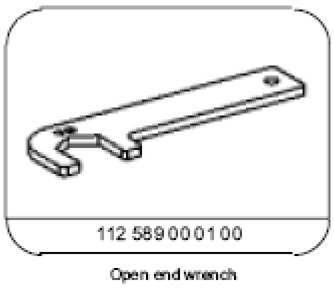


Fig. 22: Identifying Open End Wrench (112 589 00 01 00)

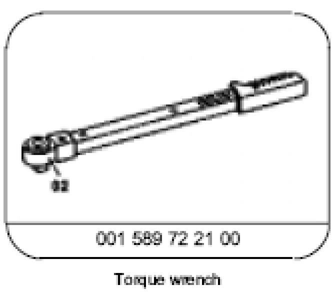


Fig. 23: Identifying Torque Wrench (001 589 72 21 00)

1. Place assembly insert (1) with the digit F1 into the riveting tool (2)and secure with bolt (3).

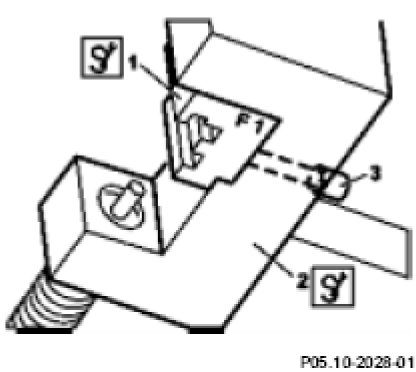


Fig. 24: Identifying Riveting Tool With Digit F1

2. Place movable assembly insert (4) with the digit D5 into the riveting tool (2).

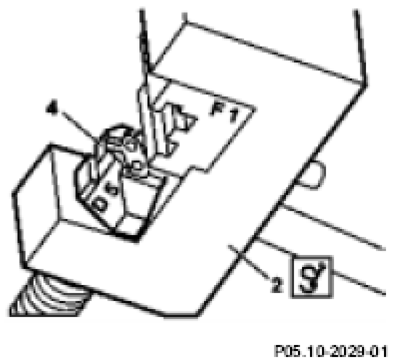


Fig. 25: Identifying Riveting Tool With Digit D5 & F1

3. Insert new outer plate (5) into the movable assembly insert (4). The outer plate (5) is held by a magnet.

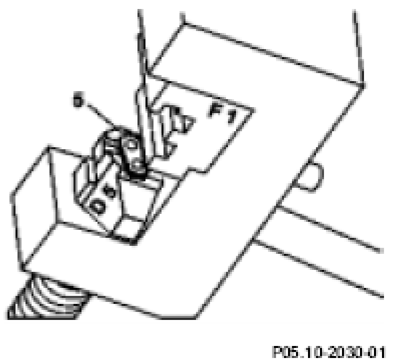


Fig. 26: Identifying Riveting Tool With New Outer Plate

4. Mark camshaft sprocket relative to timing chain by a colored dot (arrow).
5. Remove camshaft sprocket (6).

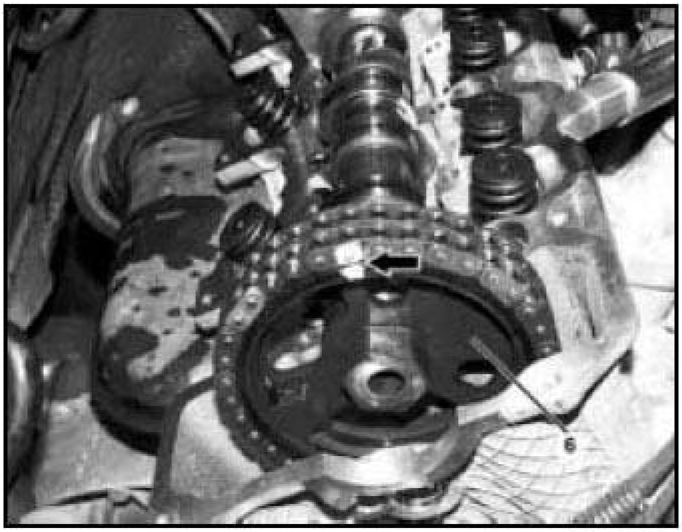


Fig. 27: Locating Colored Dot On Camshaft Sprocket

6. Place a cloth below timing chain.
7. Position riveting tool (2) so that timing chain is resting on the spacer bars (arrow).
8. Tighten spindle (7) until a firm resistance is felt.

   While turning the spindle (7) ensure that the pins of the riveted link are inserted into the holes of the outer plate.

9. Remove rivet press tool (2).

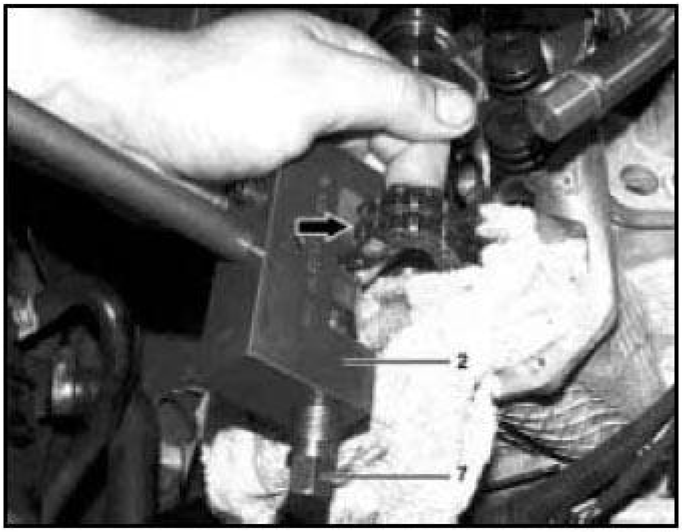


Fig. 28: Identifying Timing Chain Resting On Spacer Bars

10. Turn over moving assembly insert (4) with the digit D5 to the riveting section (arrow).

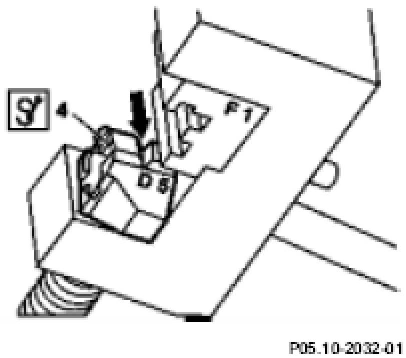


Fig. 29: Identifying Riveting Tool Assembly Insert & Riveting Section

11. Position riveting tool (2) exactly above the middle of the pins (arrow).
12. Tighten spindle (7)fully at riveting tool (2).

    Tightening torque of spindle: Reference value approx. 30 to 35 Nm.

13. Rivet pins of the riveted link individually.

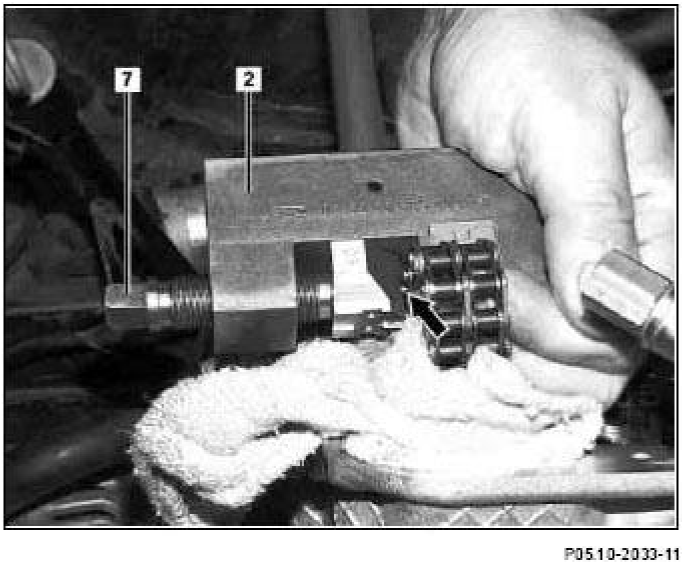


Fig. 30: Identifying Riveting Tool Exactly Above Middle Of Pins

14. Check riveting (arrows), re-rivet if necessary.
15. Fit on camshaft sprocket (6).

    Pay attention to tightening torque of camshaft sprocket.

The colored markings (8) on the timing chain and at the camshaft sprocket must be aligned.

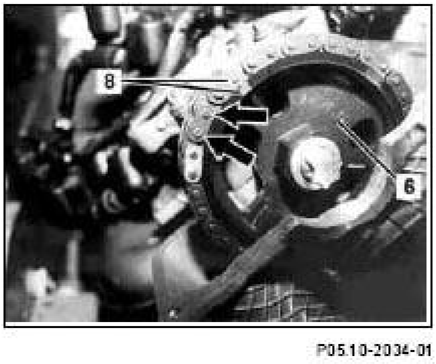


Fig. 31: Identifying Colored Markings On The Timing Chain And At The Camshaft Sprocket

DRAWING IN TIMING CHAIN - AR05.10-P-7601-04AV

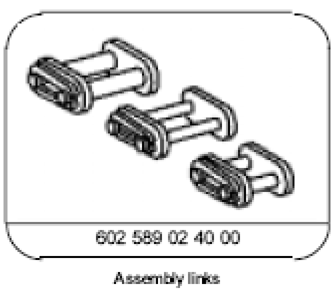


Fig. 32: Identifying Assembly Links (602 589 02 40 00)

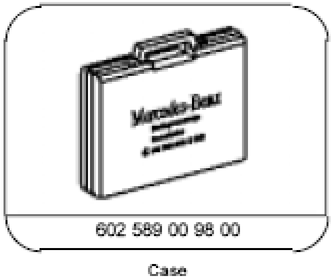


Fig. 33: Identifying Case (602 589 00 98 00)

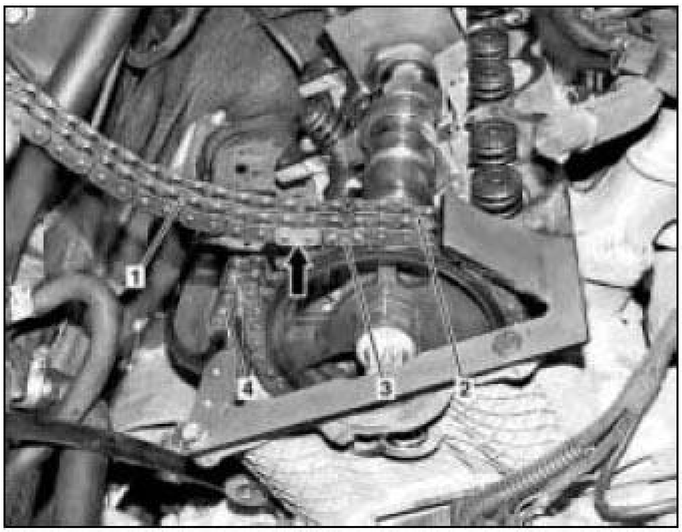
1. Connect the new timing chain (1) and the old timing chain (2) with the assembly link (3) (arrow).

   Do not use an assembly plate and an assembly retainer. While drawing in the new timing chain (1), the assembly retainer can get jammed and jump off at the slide rails.

2. Slowly rotate crankshaft in direction of rotation of engine until the ends of the new timing chain (1) can be connected.

Always keep new timing chain (1) meshed with the camshaft sprocket. Pull out the free end of the timing chain (4) steadily corresponding with the drawing in of the new timing chain (1).

3. Remove the assembly link (3) and place the old timing chain (2) to the side.



P05.10-2222-11

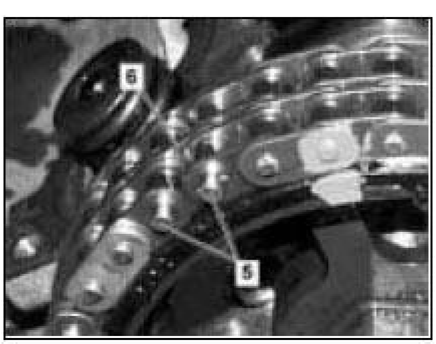
Fig. 34: Locating Assembly Link & Timing Chain

4. Cover the timing case recess with a clean cloth.

   Parts which have dropped into the timing case recess, must be removed.

5. Connect both ends of the new timing chain (1) with the new riveted link (5).

While inserting the new riveted link (5) ensure that the center plate (6) is also installed.

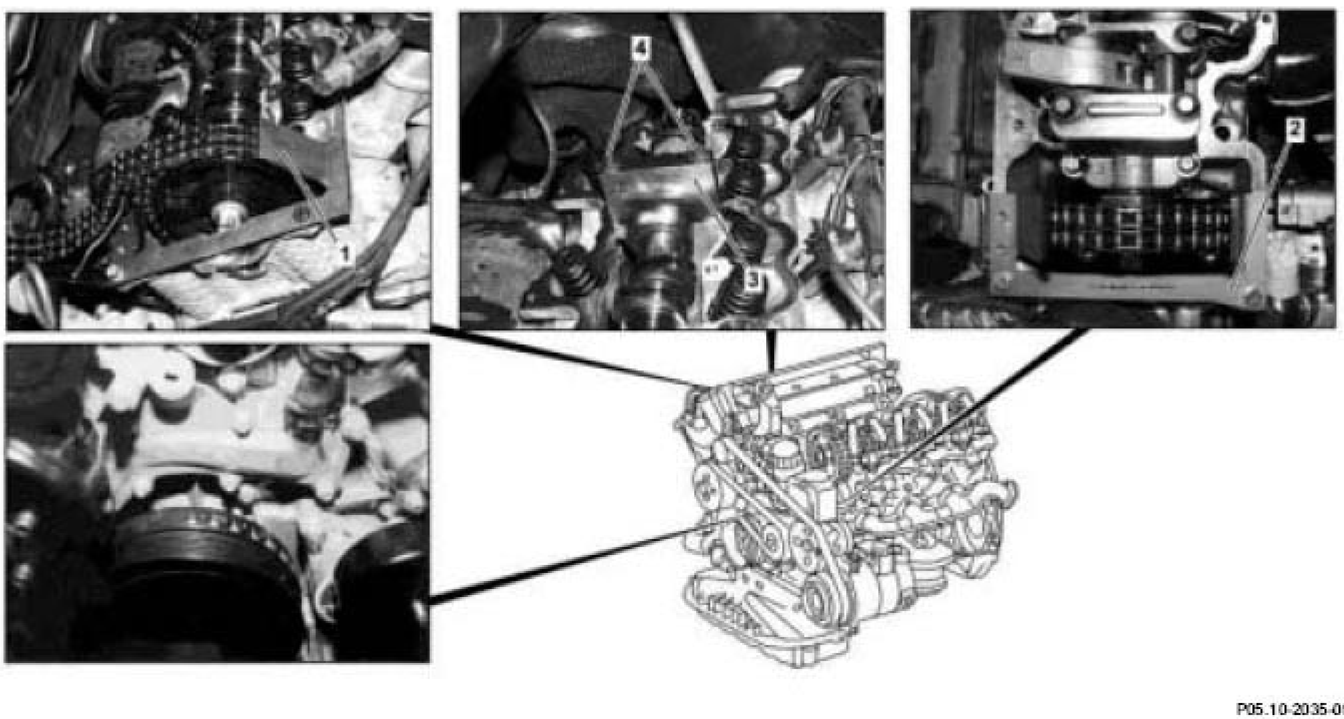


P05.10-2053-01

Fig. 35: Identifying Chain Riveted Link And Center Plate

REPLACING TIMING CHAIN - AR05.10-P-7601AA

ENGINE 112,113 / (except, 113.995) Only for vehicles with Elektrolufter



1	*Retainer for timing chain (right)*	3	*Locking bush for camshaft (right)*
2	*Locking device for timing chain (left)*	4	*Torx screws*

Fig. 36: Identifying Timing Chain Components

	Removing		
	Risk of explosion caused by oxyhydrogen gas. **Risk of poisoning and caustic burns** caused by swallowing battery acid. **Risk of injury** caused by burns to skin and eyes from battery acid or when handling damaged lead-acid batteries	No fire, sparks, open flames or smoking. Wear acid-resistant gloves, clothing and safety glasses. Only pour battery acid into suitable and appropriately marked containers.	**AS54.10-Z-0001-01A**
1	Disconnect battery ground cable	Do not connect quiescent current retention device otherwise this may cause damage to the control unit.	
		Model 203	AR54.10-P-0003P
		Models 129, 163, 170, 202, 208, 210	**AR54.10-P-0003A**
		Model 209	AR54.10-P-0003Q

		Models 211.061/065/070	AR54.10-P-0003T
		Model 215, 220	AR54.10-P-0003I
		Model 230.474 /475	AR54.10-P-0003R
		All models 463 except 463.241/248 with code 979.	AR54.10-P-0003G
		Model 463.241 with code 979	AR54.10-P-0003PV
		Model 463.248 with code 979	AR54.10-P-0003PM
	Notes on battery	All models	**AH54.10-P-0001-01A**
2	Remove spark plugs	To ensure that the engine can be easily cranked when drawing in the timing chain, and to avoid the timing chain jumping across. Remove only once spark plug of each cylinder.	
PE	Replace spark plugs	Model 163	**AP15.10-P-1580GH**
		Models 220, 230.474/475	AP15.10-P-1580AB
		Models 210, 208, 202	AP15.10-P-1580A
		Models 203, 170, 209, 211 with engine 112	
		Models 209, 211 with engine 113	
3	Remove cylinder head covers	Air filter mounted on vehicle	**AR01.20-P-5014B**
		Air filter mounted on engine	**AR01.20-P-5014BV**
4.1	Remove fan shroud	Not models 211.061/065/070, 230.475	
		Models 220, 230.474	AR20.40-P-6800AB
4.2	Remove electric fan	Model 170	AR20.40-P-5000SV
		Models 203, 209	AR20.40-P-5000PV
		Model 163.174	**AR20.40-P-5000GH**
5	Position engine to 40° after TDC of first cylinder.	Engine must not be cranked backwards. The notches of the camshafts must be pointing in the direction of the inner V. It must be possible to easily insert the two locking plates. If this is not possible: ?	
		Set the basic position of	**AR05.20-P-6020AU**

		camshafts The copper plates of the timing chain must be aligned with the scribe marks on the camshaft sprockets. Owing to the unevenly long paths of the timing chain it may be necessary to crank the engine as many as 14 times till the copper plates get aligned with the scribe marks on the camshaft sprockets. On vehicles equipped with an air pump, the combination valve must be unbolted before the right locking plate is inserted. Installation: Replace combination valve gasket.	
		AH	***BA09.20-P-1001-01D**
		Locating plate	**Fig. 11**
		Locating plate	**Fig. 12**
Danger!	Timing chain drive - general	Engines 112, 113	**GF05.10-P-9611-01C**
6	Remove chain tensioner	Models 163.174, 215, 220 Models 170, 202, 203, 208.365/465 Models 209, 210, 211061/065/070 Model 230.474 with engine 113.992	**AR05.10-P-7800CA**
7	Remove camshaft position sensor		**AR15.10-P-2000A**
8	Crank engine in direction of rotation until the link for separating the timing chain is easily accessible	The separation point for the timing chain is one link down from the copper tab (right). See new timing chain.	
9	Remove camshaft bearing bridge on right	Engine 112, 113 Engine 113.960 with code (479) Cylinder shutoff	**AR05.20-P-7103AU** AR05.20-P-7103AV
10	Install holding bush (3) onto camshaft on right	Only insert bolts (4) until they make contact.	**Fig. 40**

		Holding bush	
11	Bolt on holding devices (1, 2) for timing chain at right and left cylinder heads	Retainer	**Fig. 39**
12	Disconnect timing chain	Cover over timing case recess with a clean cloth. Parts which have dropped into the timing case recess, must be removed. To pull out the old timing chain, connect the old chain to the new timing chain.	**AR05.10-P-7601-01AV**
i	Install		
13	Draw in new timing chain	Pull in the new timing chain by turning the crankshaft in its standard direction of rotation. Assembly links Case	**AR05.10-P-7601-04AV** **Fig. 32** **Fig. 16**
14	Remove retaining devices (1, 2) for timing chain at right and left cylinder head	Retainer	**Fig. 39**
15	Rivet new timing chain		**AR05.10-P-7601-02AV**
16	Crank engine in direction of rotation		
17	Check timing of engine		**AR05.10-P-6858V**
18	Take off holding bush (3) on right camshaft	Holding bush	**Fig. 40**
19	Install camshaft bearing bridge on right	Engines 112, 113 Engine 113.960 with code (479) Cylinder shutoff	**AR05.20-P-7103AU** AR05.20-P-7103AV
20	Install camshaft position sensor		**AR15.10-P-2000A**
21	Installing chain tensioner	Models 163.174, 215, 220 Models 170, 202, 203, 208.365/465 Models 209, 210, 211061/065/070 Model 230.474 with engine 113.992	**AR05.10-P-7800CA**
22.1	Install fan shroud	Not model	AR20.40-P-6800AB

		211.061/065/070, 230.475 Models 220, 230.474	
22.2	Install electric fan	Model 170 Models 203, 209 Model 163.174	AR20.40-P-5000SV AR20.40-P-5000PV **AR20.40-P-5000GH**
23	Install cylinder head covers	Air filter located at vehicle side. Air filter located on engine side.	**AR01.20-P-5014B** **AR01.20-P-5014BV**
24 PE	Install spark plugs Replace spark plugs	Models 220, 230.474/475 Models 210, 208, 202 Models 170, 203, 209, 211 with engine 112 Models 209, 211 with engine 113 Model 163	AP15.10-P-1580AB AP15.10-P-1580A **AP15.10-P-1580GH**
25	Connect ground cable	Model 203 Models 129, 163, 170, 202, 208, 210 Model 209 Models 211.061/065/070 Model 215, 220 Model 230.474/475 All models 463 except 463.241/248 with code 979 Model 463.241 with code 979 Model 463.248 with code 979	AR54.10-P-0003P **AR54.10-P-0003A** AR54.10-P-0003Q AR61.20-P-1105T AR54.10-P-0003I AR54.10-P-0003R AR54.10-P-0003G AR54.10-P-0003PV AR54.10-P-0003PM
Nm	**Risk of accident** caused by vehicle starting off by itself when engine is running. **Risk of injury** caused by contusions and burns during starting procedure or when working near the running engine	Secure vehicle to prevent it from moving by itself. Wear closed and snug-fitting work clothes. Do not grasp hot or rotating parts.	**AS00.00-Z-0005-01A**
26	Run engine and inspect for leaks		

AH Intake manifold

Number	Designation	Engines 112, 113

BA09.20-P-1001-01D	Bolt, intake manifold M8 to cylinder head	Nm	20

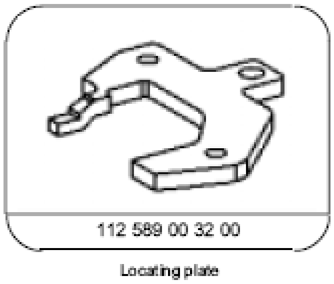


Fig. 37: Identifying Locating Plate (112 589 0032 00)

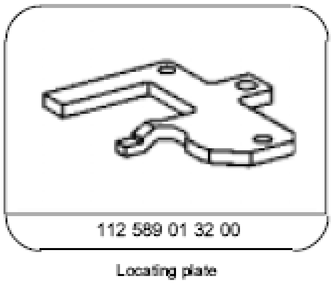


Fig. 38: Identifying Locating Plate (112 589 01 32 00)

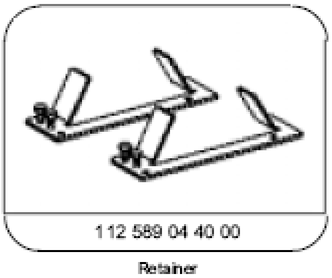


Fig. 39: Identifying Retainer (112 589 04 40 00)

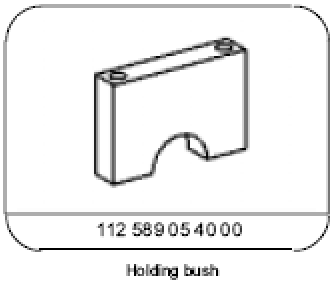


Fig. 40: Identifying Holding Bush (112 589 05 40 00)

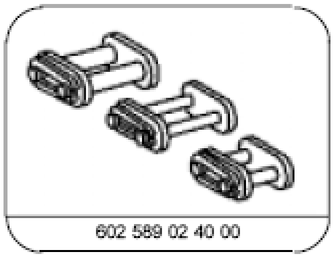


Fig. 41: Identifying Assembly Links (602 589 02 40 00)

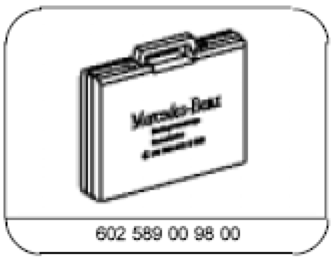


Fig. 42: Identifying Case (602 589 00 98 00)

REPLACING TIMING CHAIN - AR05.10-P-7601AV

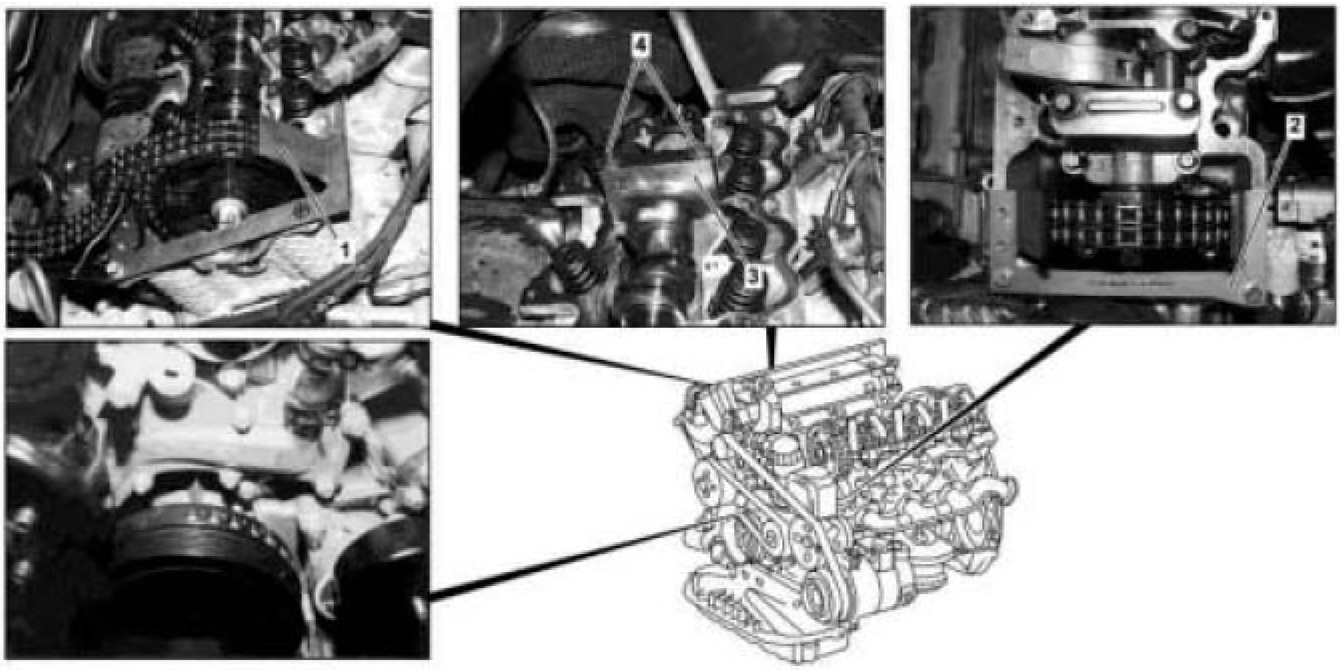
ENGINE 112

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243/246

ENGINE 113 (except 113.995) in MODEL 129, 163, 202, 203, 208, 209, 210, 211, 215, 220, 230



1	*Retainer for timing chain (right)*	3	*Locking bush for camshaft (right)*
2	*Locking device for timing chain (left)*	4	*Torx screws*

Fig. 43: Identifying Timing Chain Components

	Removing		
	Risk of explosion caused by oxyhydrogen gas. **Risk of poisoning and caustic burns** caused by swallowing battery acid. **Risk of** injury caused by burns to skin and eyes from battery acid or when handling damaged lead-acid batteries	No fire, sparks, open flames or smoking. Wear acid-resistant gloves, clothing and safety glasses. Only pour battery acid into suitable and appropriately marked containers.	**AS54.10-Z-0001-01A**
	Notes on battery	All models.	**AH54.10-P-0001-01A**
1	Disconnect ground cable	Model 463 except code (979) Special protection version	AR54.10-P-0003G
		Model 463.241 with code (979) Special protection version.	AR54.10-P-0003PV
		Model 463.248 with code 979	AR54.10-P-0003PM
		Models 129, 208, 210.	**AR54.10-P-0003A**

2	Remove spark plugs	To ensure that the engine can be easily cranked when drawing in the timing chain, and to avoid the timing chain jumping across. Remove only one spark plug at each cylinder.	
PE	Replace spark plugs	Model 463. Model 129. Models 202, 208, 210 with engine 112. Models 163.	AP15.10-P-1580GA AP15.10-P-1580A **AP15.10-P-1580GH**
3	Remove cylinder head covers	Air filter located at vehicle side. Air filter located on engine side.	**AR01.20-P-5014B** **AR01.20-P-5014BV**
4	Remove viscous-drive fan.	Right-hand thread!	**AR20.40-P-5660C**
5	Remove fan shroud	On model 163 unscrew bolts at bottom of fan shroud. Model 463.	AR20.40-P-6800V
6	Position engine at a 40° crank angle before ignition TDC of cylinder 1.	Engine must not be cranked back. The notches of the camshafts must be pointing in the direction of the inner V. It must be possible to easily insert the two locking plates. If this is not possible: ? Set the basic position of camshafts. The copper tabs of the timing chain must be aligned with the markings on the camshaft sprockets. Because of the unevenly long travel of the timing chain it may be necessary to crank the engine as much as 14 times until the copper tabs are aligned with the markings on the	 **AR05.20-P-6020AU**

		camshaft sprockets. On vehicles equipped with an air pump, the combination valve must be unbolted before the right locking plate is inserted. **Installation** : Replace Gasket of combination valve. AH Locating plate Locating plate	***BA09.20-P-1001-01D** **Fig. 11** **Fig. 12**
Danger!	Timing chain drive - general		**GF05.10-P-9611-01C**
7	Remove chain tensioner		**AR05.10-P-7800C**
8	Remove camshaft position sensor		**AR15.10-P-2000A**
9	Crank engine in direction of rotation until the link for separating the timing chain is easily accessible	The separation point for the timing chain is one link down from the copper tab (right). See new timing chain.	
10	Remove camshaft bearing bridge on right	Engine 112, 113. Engine 113.960 with Code (479) cylinder shutoff.	**AR05.20-P-7103AU** AR05.20-P-7103AV
11	Install holding bush (3) onto camshaft on right	Insert bolts (4) only until they make contact.	**Fig. 40**
12	Bolt on holding devices (1, 2) for timing chain at right and left cylinder heads		**Fig. 39**
13	Separate timing chain	Parts which have dropped into the timing case recess, must be removed. Cover over timing case recess with a clean cloth.	**AR05.10-P-7601-01AV**
		Connect old timing chain to new timing chain before pulling out.	
i	**Installing**		
14	Draw in new timing chain	Pull in the new timing chain by turning the	**AR05.10-P-7601-04AV**

		crankshaft in its standard direction of rotation.	
15	Remove retaining devices (1, 2) for timing chain at right and left cylinder head		**Fig. 39**
16	Rivet new timing chain		**AR05.10-P-7601-02AV**
17	Crank engine in direction of rotation		
18	Check timing of engine		**AR05.10-P-6858V**
19	Take off holding bush (3) on right camshaft		**Fig. 40**
20	Install camshaft bearing bridge on right	Engines 112, 113. Engine 113.960 with code (479) Cylinder shutoff.	**AR05.20-P-7103AU** AR05.20-P-7103AV
21	Install camshaft position sensor		**AR15.10-P-2000A**
22	Installing chain tensioner		**AR05.10-P-7800C**
23	Install fan shroud	Model 463.	AR20.40-P-6800V
24	Install viscous-drive fan	Right-hand thread!	**AR20.40-P-5660C**
25	Install cylinder head covers	Air filter located at vehicle side. Air filter located on engine side.	**AR01.20-P-5014B** **AR01.20-P-5014BV**
26 PE	Install spark plugs Replace spark plugs	Model 463. Model 129. Models 202, 208, 210 with engine 112. Models 163.	AP15.10-P-1580GA AP15.10-P-1580A **AP15.10-P-1580GH**
27	Connect ground cable	Model 463 except code (979) Special protection version Models 463.241 with code (979) Special protection version. Model 463.248 with code 979 Models 129, 208, 210.	AR54.10-P-0003G AR54.10-P-0003PV AR54.10-P-0003PM **AR54.10-P-0003A**
Nm	**Risk of accident** caused by vehicle starting off by itself when engine is running. **Risk of injury** caused by contusions and	Secure vehicle to prevent it from moving by itself. Wear closed and snug-fitting work clothes. Do not grasp hot or	**AS00.00-Z-0005-01A**

	burns during starting procedure or when working near the running engine	rotating parts.	
28	Run engine and inspect for leaks		

AH Intake manifold

Number	Designation		Engines 112,113
BA09.20-P-1001-01D	Bolt, intake manifold M8 to cylinder head	Nm	20

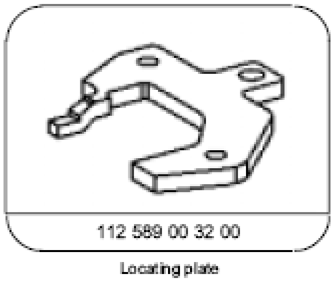


Fig. 44: Identifying Locating Plate (112 589 00 32 00)

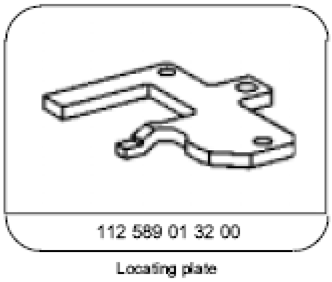


Fig. 45: Identifying Locating Plate (112 589 01 32 00)

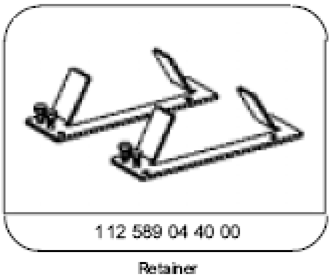


Fig. 46: Identifying Retainer (112 589 04 40 00)

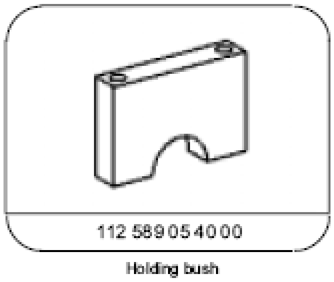


Fig. 47: Identifying Holding Bush (112 589 05 40 00)

REMOVE/INSTALL CHAIN TENSIONER - AR05.10-P-7800C

ENGINE 112.945 in MODELS 463.209 /232 /233 /244 /245 /250

ENGINE 112 in MODELS 163, 129

ENGINE 113.962 in MODELS 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113 (except 113.965 /981) in MODELS 210, 208, 202, 163, 129

ENGINE 113.982 in MODELS 463.243 /246

Shown on ENGINE 112 in MODEL 129

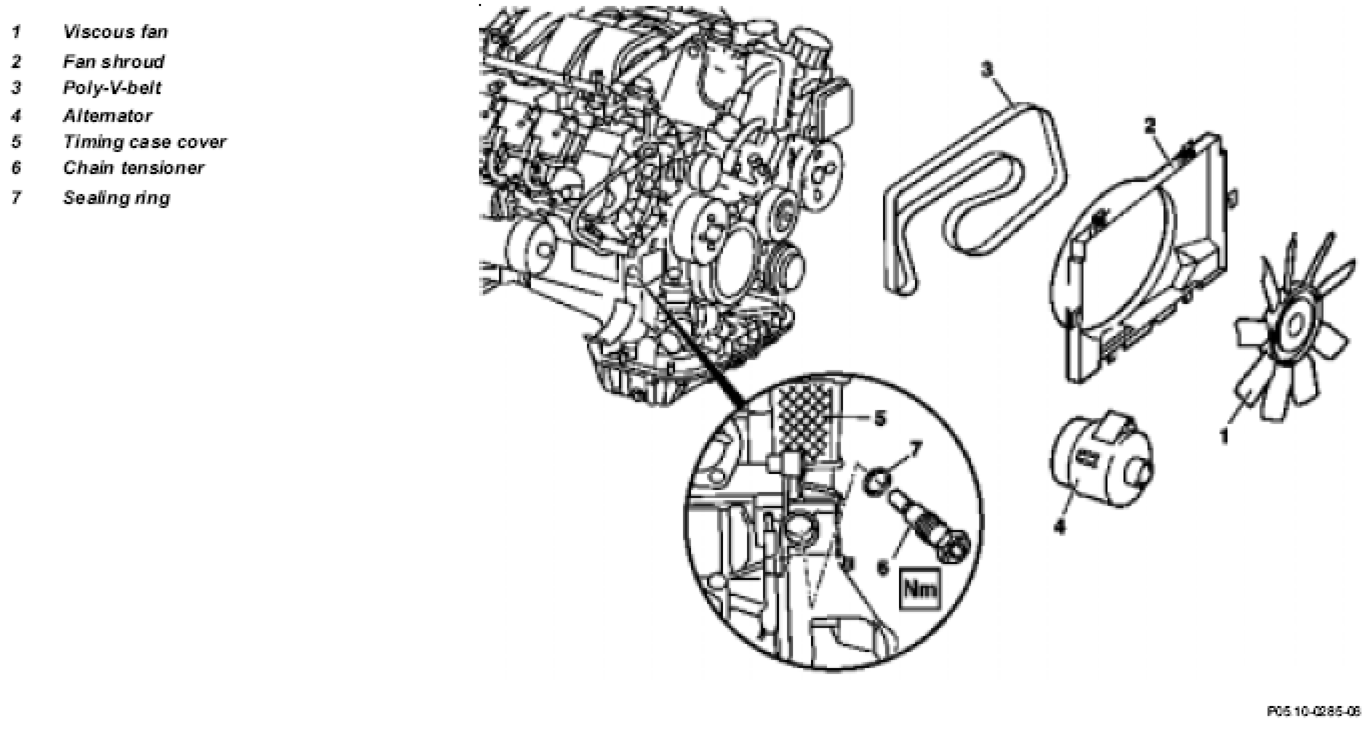


Fig. 48: Identifying Chain Tensioner Components - Shown On Engine 112 In Model 129

	Remove/install		
1	Remove viscous fan (1)	Right-hand thread!	**AR20.40-P-5660C**
2	Remove fan shroud (2).	On model 163 unscrew bolts at bottom of fan shroud. Model 463	 AR20.40-P-6800V
3	Remove poly-V belt (3)	Installation: Lock tensioning device with a drift or pin (diameter 5 mm).	**AR13.22-P-1202B**
4	Remove alternator (4)	Model 129 Model 163 Model 208 with engine 113 Model 210 with engine 113 Model 463 with engine 112, 113	AR15.40-P-5032CT **AR15.40-P-5032GH** AR15.40-P-5032EB AR15.40-P-5032ED AR15.40-P-5032GV
5 Danger!	Take chain tensioner (6) off timing case cover (5) Design of chain tensioner	**Installation:** Replace seal (7). AH Engines 112, 113	 ***BA05.10-P-1001-01C** **GF05.10-P-7801-01A**
6	Install in the reverse order		

AH Timing chain, chain tensioner

Number	**Designation**	**Engines 112.910/911/ 912/913/914/ 915/916/917/ 920/921/922/ 923/940/941/ 942/943/944/ 945/946/947/ 949/951/953/ 954/955/960/ 961/970/972/ 973/975/976**	**Engines 113.940/941/ 942/943/944/ 945/946/948/ 960/961/962/ 963/964/965/ 966/967/968/ 969/971/980/ 981/982/984/ 986/987/988/ 990/991/992/ 993/995**
BA05.10-P-1001-01C	Chain tensioner in timing case cover Nm	80	80

REMOVE/INSTALL CHAIN TENSIONER - AR05.10-P-7800CA

ENGINE 112 in MODELS 170, 208, 202, 210, 209, 203

ENGINE 113 in MODELS 163.174 /175, 209.375 /475

ENGINE 113.987 in MODELS 209.376 /476 up to 23.4.04

Shown on engine 112

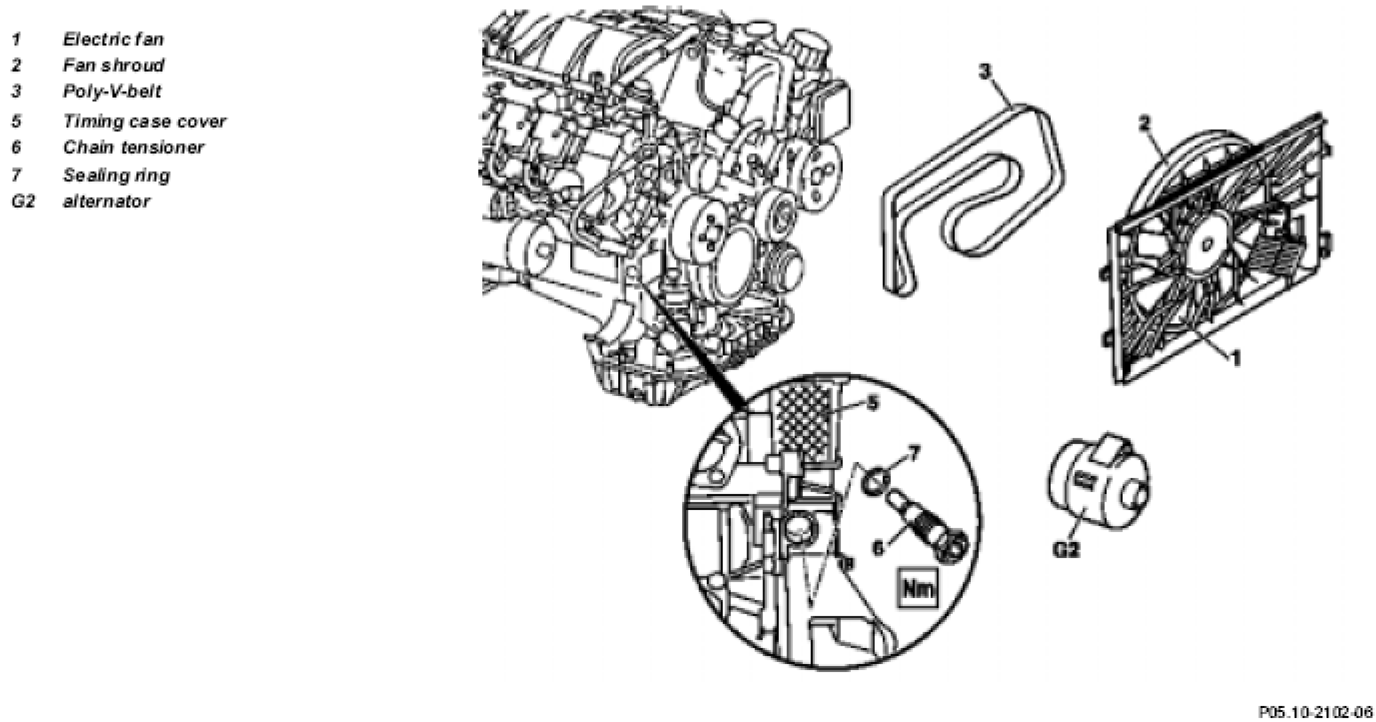


Fig. 49: Identifying Chain Tensioner Components - Shown On Engine 112

	Remove/install		
1.1	Remove fan shroud (2) together with electric fan	Models 208, 210 with engine 112	
1.2	Remove electric fan (1)	Model 170.465 with engine 112.947 Model 170.466 with engine 112.960	AR20.40-P-5000SV
		Models 203.061 /261 with engine 112.912 Models 203.064 /264 /764 with engine 112.946 Models 203.065 /265 with engine 112.961 Models 203.081 /281 with engine 112.916 Models 203.084 /284 with engine 112.953	AR20.40-P-5000PV

		Models 209.361 /461 with engine 112.912 Models 209.365 /465 with engine 112.955 Models 209.375 /475 with engine 113.968 Models 209.376 /476 with engine 113.987	
		Model 163.174 with engine 113.981 Model 163.175 with engine 113.965	**AR20.40-P-5000GH**
2.1	Remove alternator (G2)	On alternator (G2)only unscrew upper bolt, slacken lower bolt. Fold away the alternator (G2).	
		Models 202.088, 210.061 /062/261 /262	
		Models 163.174/175 with ENGINE 113	**AR15.40-P-5032GH**
		Model 170 with Engine 112	AR15.40-P-5032G
		Models 203.061 /261 with engine 112.912 Models 203.064 /264 /764 with engine 112.946 Models 203.065 /265 with engine 112.961 Models 209.361 /461 with engine 112.912 Models 209.365 /465 with engine 112.955 Models 209.375 /475 with engine 113.968 Models 209.376 /476 with ENGINE 113.987	AR15.40-P-5032P
		Models 203.081 /084 /281 /284 with engine 112	AR15.40-P-5032PW
		Model 202 with engine 112.910 /920, except 202.088 with engine 112 Model 208 with engine 112.940, 113.943 /984	AR15.40-P-5032EB
		Model 210 with engine 112.921 /941, except	AR15.40-P-5032ED

		210.061 /062 /261 /262 with engine 112 Models 210.061 /062/261 /262 Model 202.088 External Torx set	**Fig. 50**
3	Remove chain tensioner (6) from timing case cover (5)	**Installation:** Replace seal (7). AH	***BA05.10-P-1001-01C**
Danger!	Design of chain tensioner	Engine 112, 113	**GF05.10-P-7801-01A**
4	Install in the reverse order		

AH Timing chain, chain tensioner

Number	Designation		Engines 112.910/911/ 912/913/914/ 915/916/917/ 920/921/922/ 923/940/941/ 942/943/944/ 945/946/947/ 949/951/953/ 954/955/960/ 961/970/972/ 973/975/976	Engines 113.940/941/ 942/943/944/ 945/946/948/ 960/961/962/ 963/964/965/ 966/967/968/ 969/971/980/ 981/982/984/ 986/987/988/ 990/991/992/ 993/995
BA05.10-P-1001-01C	Chain tensioner in timing case cover	Nm	80	80

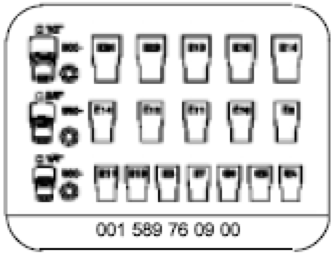


Fig. 50: Identifying External Torx Set (001 589 76 09 00)

REMOVE/INSTALL SLIDE RAIL IN TIMING CASE COVER - AR05.10-P-8484V

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

ENGINE 112 in MODEL 129, 163, 170, 202, 203, 208, 209, 210, 211, 220

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249

ENGINE 113 // (except 113.990 /991 /995) in MODEL 129, 163, 202, 203, 208, 209, 210, 211, 215, 220, 230

ENGINE 113.982 in MODEL 463.243/246

Shown on engine 112

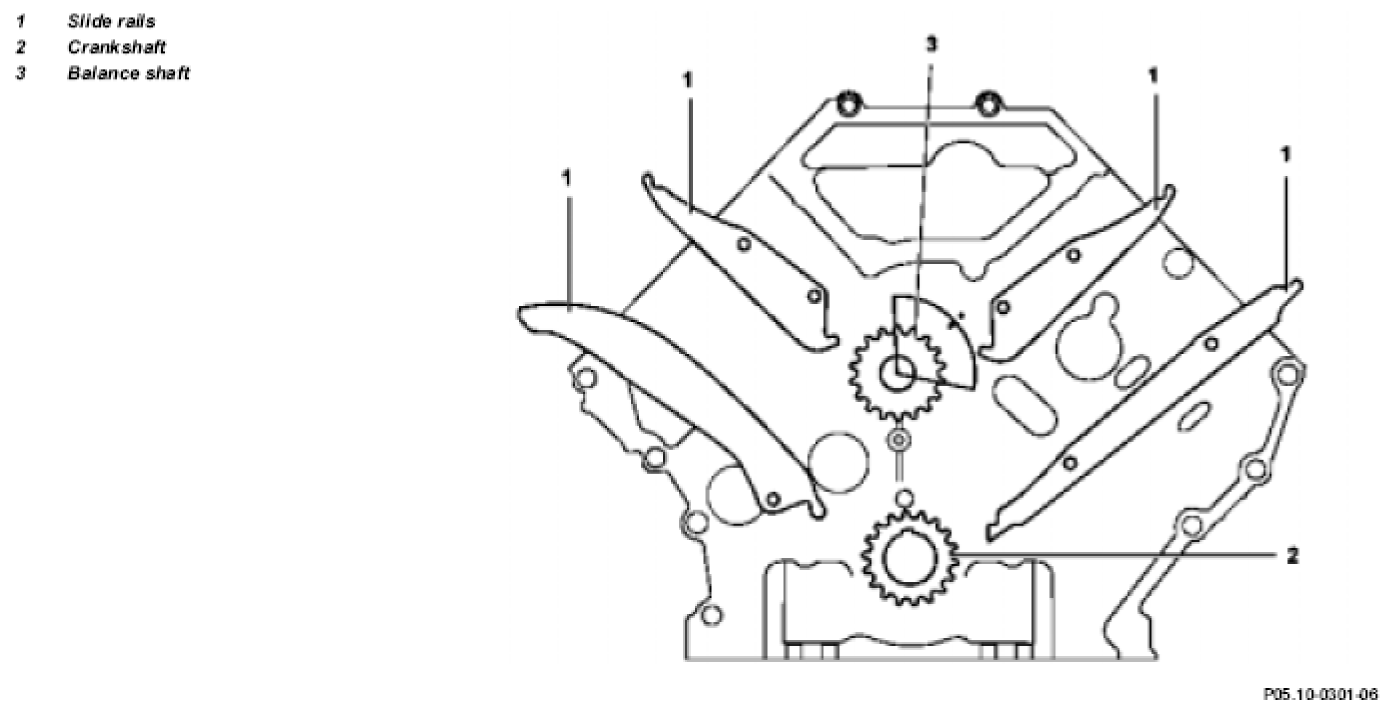


Fig. 51: Identifying Slide Rail In Timing Case Cover Components - Shown On Engine 112

Modification notes

20.12.04	Engine oil filling capacity with oil filter modified.	Engine 113.967	***BF18.00-P-1001-01H**

	Remove/install		
Nm	**Risk of death** caused by vehicle slipping or toppling off the lifting platform.	Align vehicle between the columns of the and position the four support plates below the lifting platform support points specified by the vehicle manufacturer.	**AS00.00-Z-0010-01A**
1	Remove engine compartment paneling	Models 129, 202, 208, 210 Model 230.474 /475 Model 215, 220 Models 203, 209 Model 211 Models 170, 202.0	AR61.20-P-1105AB AR61.20-P-1105R AR61.20-P-1105M AR61.20-P-1105P AR61.20-P-1105T AR61.20-P-1105A

		Models 163.172/174/175	**AR61.20-P-1105GH**
2.1	Remove under-ride guard	Model 463.246 with engine 113.982	AR88.30-P-0010MG
3.1	Remove air baffle	Model 163 with engine 113.942	
4	Drain and collect engine oil	**Installation:** Replace sealing ring of the oil drain screw. AH Oil drain plug to oil pan M14 GF Engine lubrication	 ***BA01.45-P-1003-01B** ***BF18.00-P-1001-01H**
5	Remove cylinder heads	Model 129 with engine 112 Models 129, 202, 208, 210 with engine 113 Models 170, 202, 208, 210 with engine 112 Model 220 with engines 112, 113 Models 215.374, 230.474/ 475 Models 203.764, 215.373/ 375 Model 463 Models 203, 209, 211.061 /065 /070 /080/ 082 /083 /280 /282 /283 Model 163	AR01.30-P-5800B AR01.30-P-5800BA AR01.30-P-5800GV AR01.30-P-5800PV **AR01.30-P-5800MV**
6	Remove oil pan bottom section	Models 129, 202, 208, 210, 220 without 4MATIC Model 170 with engine 112 Model 463 with engines 112.945, 113.962/982 Model 220/211 with 4MATIC Models 215.374, 230.474/ 475 Models 203.764, 215.373/ 375 Models 203.061/064/ 065/ 261/ 264/ 265 Model 209 Models 211.061 /065/070 Model 203 with 4MATIC Models 203.076/ 276 Models 163.154/157/172 Models 163.174/175	AR01.45-P-7555VA AR01.45-P-7555IW AR01.45-P-7555R AR01.45-P-7555PV AR01.45-P-7555PW AR01.45-P-7555AC **AR01.45-P-7555V** **AR01.45-P-7555VE**
7	Remove timing case cover	Model 170, 210.061 /063 /065 /261 /263/ 265 /663 with engine 112 Models 129, 163, 202, 208, 210, 230 with engine 113	**AR01.40-P-8000B**

		Model 220 except 220.074 /174 with engine 113 Do not remove top part of oil pan!	
		Model 463 Do not remove top part of oil pan!	AR01.40-P-8000GV
		Model 210 with 4MATIC	AR01.40-P-8000GV
		Models 203.061 /064 /065 /081 /084 /261/ 264 /265 /281 /284 /076 /276	AR01.40-P-8000V
		Models 209.361/365/ 375/ 376/ 461/ 465/ 475/ 476	AR01.40-P-8000PV
		Models 211.061 / 065/ 070/ 080/ 082/ 083/ 280/ 282/ 283	
		Models 220.074/174	AR01.40-P-8000RVK
		Model 215.374	
		Model 203.764	
		Models 210.062/262	
		Models 215.373/375	
8	Remove slide rails (1)	At the same time detach slide rails (1) toward front from the retaining bolts.	
9	Install in the reverse order		

AH Oil pan

Number	**Designation**			**Engines 112.910/911/ 912/913/914/ 915/917/920/ 921/922/923/ 940/941/942/ 943/944/945/ 946/947/949/ 951/954/955/ 960/961/970/ 972/973/976**	**Engines 113.940/941/ 942/943/944/ 945/946/960/ 961/962/963/ 965/967/968/ 969/980/981/ 982/984/986/ 992/995**
BA01.45-P-1003-01B	Oil drain screw to oil pan	M14	Nm	30	30

AH Oil pan

Number	**Designation**	**Engine 112.916/953/975,**	**Engine 113.987/ 988/991**

				113.948/966	
BA01.45-P-1003-01B	Oil drain screw to oil pan	M14	Nm	30	30

GF **Engine lubrication**

Number	**Designation**			**Engine 112 except 112.916/953/975**	**Engine 112.916/953**	**Engine 113.948/966**
BF18.00-P-1001-01H	Engine oil	Filling capacity with oil filter	Liters	8.0	7.5	8.0
		Filling capacity without oil filter	Liters	7.5	7.0	7.5
		Specifications for Operating Fluids	Sheet	**BB00.40-P-0229-01A**	**BB00.40-P-0229-01A**	**BB00.40-P-0229-01A**
			Sheet	**BB00.40-P-0229-03A**	**BB00.40-P-0229-03A**	**BB00.40-P-0229-03A**
			Sheet	**BB00.40-P-0229-05A**	**BB00.40-P-0229-05A**	**BB00.40-P-0229-05A**

GF **Engine lubrication**

Number	**Designation**			**Engine 113.944/944/980981/984/984/986/991**	**Engine 113.963/963/965**	**Engines 113.987/988/990/**
BF18.00-P-1001-01H	Engine oil	Filling capacity with oil filter	Liters	7.5	7.5	8.5
		Filling capacity without oil filter	Liters	-	7.0	8.0
		Specifications for Operating Fluids	Sheet	-	**BB00.40-P-0229-01A**	-
			Sheet	-	**BB00.40-P-0229-03A**	-
			Sheet	**BB00.40-P-0229-05A**	**BB00.40-P-0229-05A**	**BB00.40-P-0229**

GF **Engine lubrication**

Number	**Designation**			**Engines 113.940/941/942/943/960/961/962/969/982**	**Engine 112.975**	**Engine 113.967**
BF18.00-P-1001-01H	Engine oil	Filling capacity with oil filter	Liters	8.0	8.0	7.5

		Filling capacity without oil filter	Liters	-	7.5	-
		Specifications for Operating Fluids	Sheet	**BB00.40-P-0229-01A**	**BB00.40-P-0229-01A**	**BB00.40-P-0229-01A**
			Sheet	**BB00.40-P-0229-03A**	**BB00.40-P-0229-03A**	**BB00.40-P-0229-03A**
			Sheet	**BB00.40-P-0229-05A**	**BB00.40-P-0229-05A**	**BB00.40-P-0229-05A**

REMOVE/INSTALL ROCKER ARMS - AR05.20-P-2340AU

ENGINE 112

ENGINE 113 except CODE (479) Cylinder shutoff

ENGINE 112.945 in MODELS 463.209 /232 /233 /244 /245 /250

ENGINE 113.962 in MODELS 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODELS 463.243 /246

Shown on engine 112

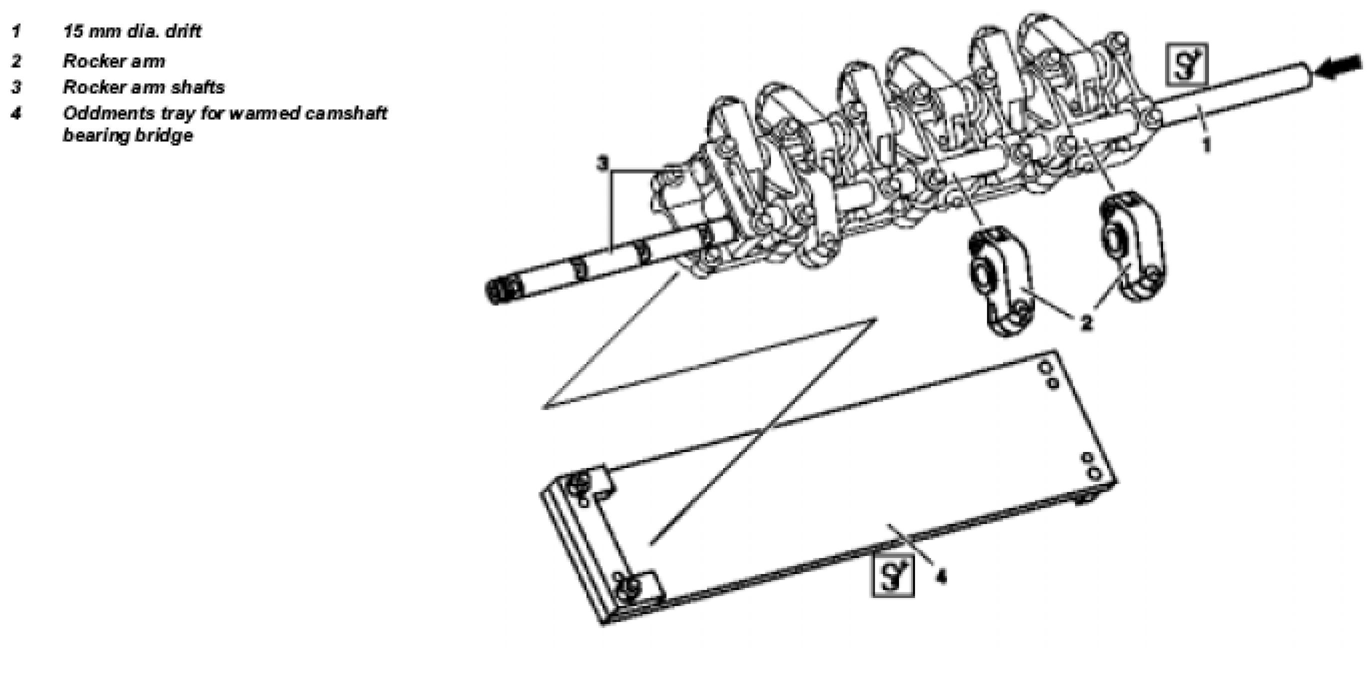


Fig. 52: Identifying Rocker Arm Components - Shown On Engine 112

	Removing		
1	Remove camshaft bearing bridge	Pay attention to slackening diagram. All models except 171.473, 164.175, 251.075/175, 219.375/376 Model 164.175 Models 251.075/175 Models 219.375/376 Model 171.473	**AR05.20-P-7103AU** AR05.20-P-7103GZ AR05.20-P-7103RT AR05.20-P-7103TY AR05.20-P-7103VT
	Risk of injury to skin and eyes caused by handling hot or glowing objects.	Wear safety gloves, protective clothing and safety glasses, if necessary.	**AS00.00-Z-0002-01A**
2	Remove the rocker arm spindles (3)	If the rocker arm spindle (3) is not able to move easily in its bearings (clamps), the camshaft bearing bridge must be warmed up: ? Warm up camshaft bearing bridge Drift punch Support plate Recirculated air warming cabinet Heating oven	 **AR05.20-P-2350AU** **Fig. 53** **Fig. 56** ***WH58.30-Z-1001-28A** ***WH58.30-Z-1003-28A**
3	Remove rocker arm (2)	Take out 15 mm dia. drift (1).	
	Install		
4	Check bearing surfaces of rocker arm (2) for damage	Pay attention to any long score marks caused by the removal of the rocker arm spindles (3). If damage is present ? Replace rocker arms (2).	
5	Introduce guide shaft into camshaft bearing bridge	At the same time preassemble the rocker arms (2) on the guide shaft. 16 mm dia. guide shaft 18 mm dia. guide shaft	 **Fig. 54** **Fig. 55**
	Risk of injury to skin and eyes caused by handling hot or glowing objects.	Wear safety gloves, protective clothing and safety glasses, if necessary. If the rocker arm spindle (3) cannot be easily introduced into its bearings (clamps), the camshaft bearing bridge must be warmed up: ? Heat the camshaft bearing bridge and drive out the	**AS00.00-Z-0002-01A** **AR05.20-P-**

6	Install the rocker arm spindles (3)	guide shaft with the rocker arm spindle (3). Ensure that the rocker arms (2) do not get jammed. USA Recirculated air warming cabinet USA Heating oven	**2350AU** ***WH58.30-Z-1001-28A** ***WH58.30-Z-1003-28A**
7	Install camshaft bearing bridge	Observe tightening pattern. All models except 171.473, 164.175, 251.075/175, 219.375/376 Model 164.175 Models 251.075/175 Models 219.375/376 Model 171.473 AH AH	**AR05.20-P-7103AU** AR05.20-P-7103GZ AR05.20-P-7103RT AR05.20-P-7103TY AR05.20-P-7103VT ***BA05.20-P-1002-01B** ***BA05.20-P-1004-01B**

AH Camshaft

Number	Designation				Engine 112 except 112.951/976	Engine 112.951/ 976
BA05.20-P-1002-01B	Bolt, camshaft bearing bridge to cylinder head	M7x45	Stage 1	Nm	15	15
			Stage 2	Angle°	-	-
BA05.20-P-1004-01B	Bolt, camshaft bearing bridge to cylinder head	M7x84	Stage 1	Nm	10	10
			Stage 2	Angle°	90	90

AH Camshaft

Number	Designation	Engines 113.940/941/ 942/943/944/ 948/961/962/ 963/964/965/ 966/967/968/ 969/971/980/	Engine 113.960 without code 479

					981/982/984/ 986/992/995	
BA05.20-P-1002-01B	Bolt, camshaft bearing bridge to cylinder head	M7x45	Stage 1	Nm	15	15
			Stage 2	Angle°	-	-
BA05.20-P-1004-01B	Bolt, camshaft bearing bridge to cylinder head	M7x84	Stage 1	Nm	10	10
			Stage 2	Angle°	90	90

AH Camshaft

Number	Designation				Engine 113.987/988/ 990/993	Engine 113.989/	Engine 113.991
BA05.20-P-1002-01B	Bolt, camshaft bearing bridge to cylinder head	M7x45	Stage 1	Nm	8	8	8
			Stage 2	Angle°	120	120	120
BA05.20-P-1004-01B	Bolt, camshaft bearing bridge to cylinder head	M7x84	Stage 1	Nm	8	8	8
			Stage 2	Angle°	120	120	120

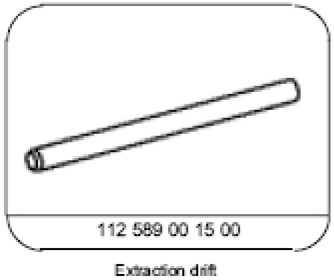


Fig. 53: Identifying Extraction Drift (112 589 00 15 00)

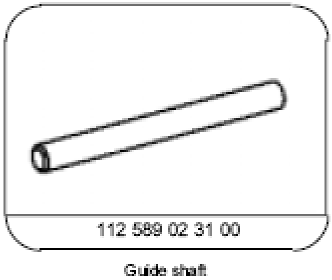


Fig. 54: Identifying Guide Shaft (112 589 02 31 00)

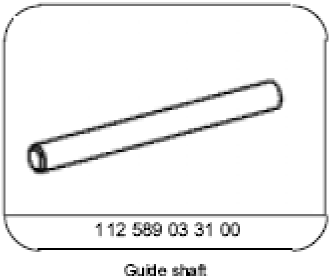


Fig. 55: Identifying Guide Shaft (112 589 03 31 00)

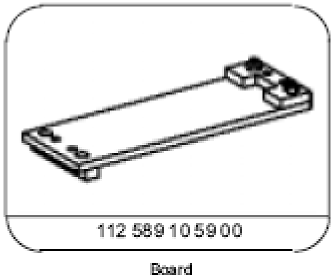


Fig. 56: Identifying Board (112 589 10 59 00)

Commercially available tools

Number	Designation
WH58.30-Z-1001-28A	Recirculated air warming cabinet
WH58.30-Z-1003-28A	Heating oven

REMOVING/INSTALLING THE ROCKER ARM SHAFT - AR05.20-P-2350AU

ENGINE 112

ENGINE 113 (except 113.960)

ENGINE 113

ENGINE 113.960 except CODE (479) Cylinder shutoff

Shown on engine 112 1 Drift punch

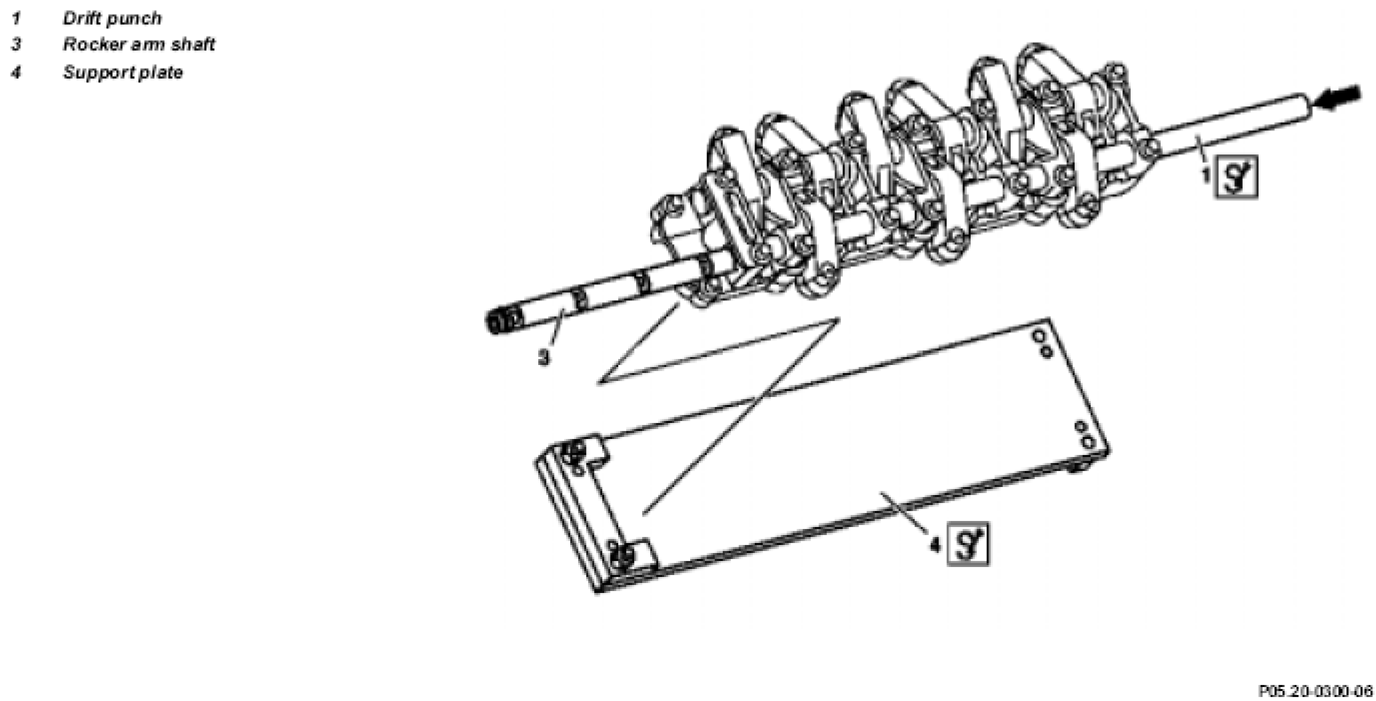


Fig. 57: Identifying Rocker Arm Shaft Components - Shown On Engine 112

	Removing		
1	Remove camshaft bearing bridge	Engines 112, 113 except engines 113.967/990 in models 219, engines 113.964 /971 /989 /993	**AR05.20-P-7103AU**
		Engine 113.993 in model 463	AR05.20-P-7103GX
		Engines 113.967/990 in model 219	AR05.20-P-7103TY
		Engine 113.964 in model 164	AR05.20-P-7103GZ
		Engine 113.971 in model 251	AR05.20-P-7103RT
		Engine 113.989 in model 171	AR05.20-P-7103VT
Nm	**Risk of injury** to skin and eyes caused by handling hot or glowing objects.	Wear safety gloves, protective clothing and safety glasses, if necessary.	**AS00.00-Z-0002-01A**
2	Heat camshaft bearing bridge to approx. 150° C	Heat the camshaft bearing bridge uniformly, but do not heat it over 160°C; there is a danger of structural changes. USA i040	***WH58.30-Z-1001-28A**

		USA i040	***WH58.30-Z-1003-28A**
3	Place camshaft bearing bridge on board (4)	◁◑	**Fig. 56**
4	Remove the rocker arm spindle (3) by tapping gently with a hammer	If it is tapped very hard, there is a danger of distorting the camshaft bearing bridge and damaging the hollow rocker arm spindle (3). ◁◑	**Fig. 53**
	Check		
5	Inspect bearing surfaces of rocker arms for damage	Pay attention to any long score marks caused by the removal of the rocker arm spindles (3). Replace the rocker arm if damaged.	
i	**Installing**		
6	Insert the guide shafts into the camshaft bearing bridge.	At the same time, preassemble the rocker arm on guide shaft. ◁◑ ◁◑	**Fig. 54** **Fig. 55**
Nm 7	**Risk of injury** to skin and eyes caused by handling hot or glowing objects. Heat camshaft bearing bridge to approx. 150° C	Wear safety gloves, protective clothing and safety glasses, if necessary. Heat the camshaft bearing bridge uniformly, but do not heat it over 160°C; there is a danger of structural changes. USA USA	**AS00.00-Z-0002-01A** WH58.30-Z-1001-28A ***WH58.30-Z-1003-28A**
8	Cool the rocker arm spindle (3)		
9	Place heated camshaft bearing bridge on board (4)	◁◑	**Fig. 56**
10	Install rocker arm spindle (3)	Insert the rocker arm spindle (3) in the camshaft bearing bridge by tapping gently with a hammer and simultaneously remove the guide shaft. Ensure that the rocker arms do not get jammed.	
11	Align the rocker arm spindle (3)	In order to align and secure the rocker arm spindle (3), fit two screws through the mounting bores in the camshaft bearing bridge. The oil supply bores of the rocker arm spindle (3) point towards the cylinder head.	
		Engines 112, 113 except engines 113.967 /990 in models 219, engines 113.964 /971 /989 /993 Engine 113.993 in model 463	**AR05.20-P-7103AU** AR05.20-P-7103GX

12	Install camshaft bearing bridge	Engines 113.967/ 990 in model 219	AR05.20-P-7103TY
		Engine 113.964 in model 164	AR05.20-P-7103GZ
		Engine 113.971 in model 251	AR05.20-P-7103RT
		Engine 113.989 in model 171	AR05.20-P-7103VT

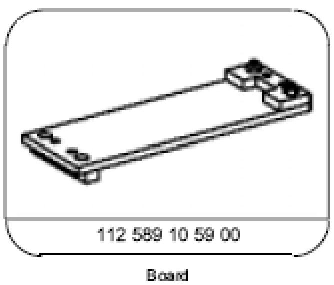


Fig. 58: Identifying Board (112 589 10 59 00)

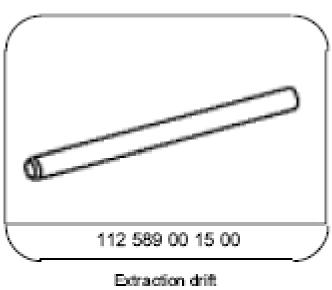


Fig. 59: Identifying Extraction Drift (112 589 00 15 00)

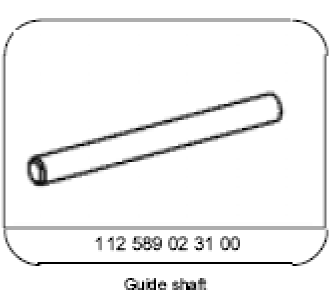


Fig. 60: Identifying Guide Shaft (112 589 02 31 00)

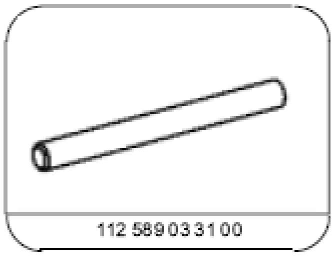


Fig. 61: Identifying Guide Shaft (112 589 03 31 00)

Commercially available tools

Number	Designation
WH58.30-Z-1001-28A	Recirculated air warming cabinet
WH58.30-Z-1003-28A	Heating oven

SET THE BASIC POSITION OF CAMSHAFTS - AR05.20-P-6020AU

ENGINE 112

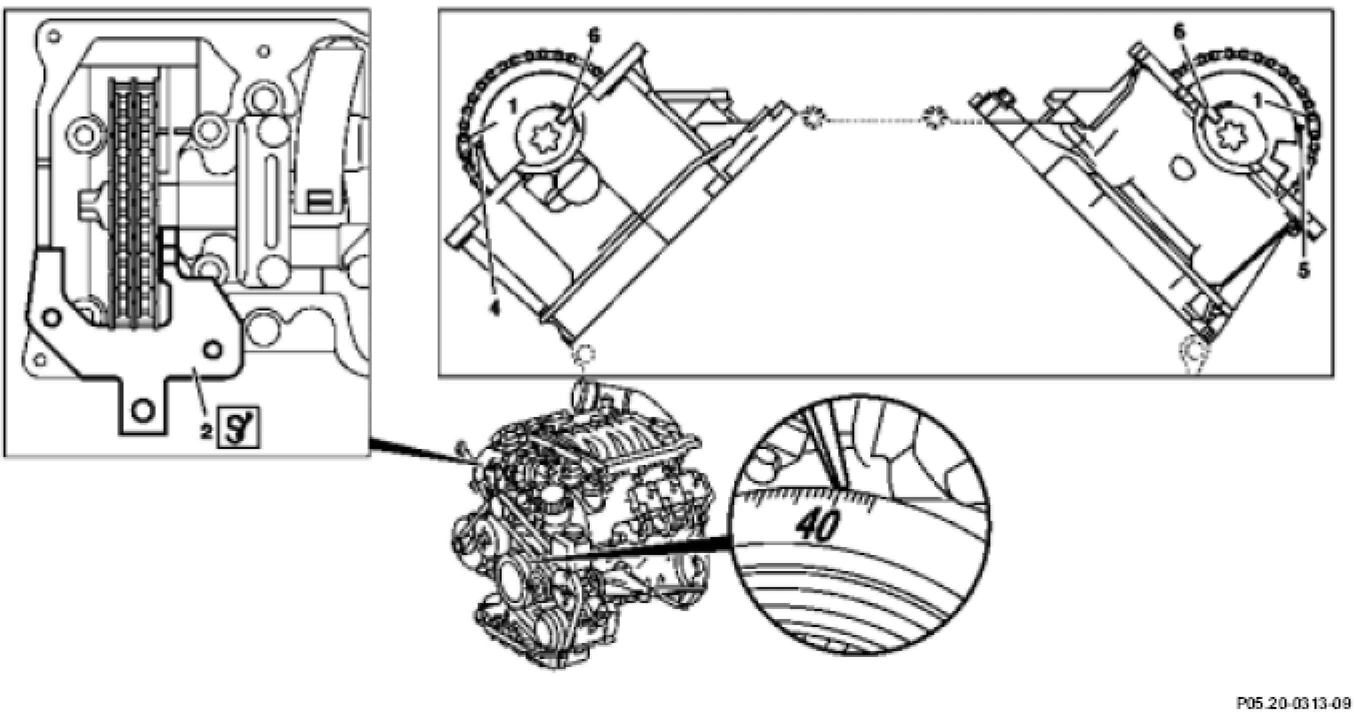
ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243/246

ENGINE 113 (except 113.995) in MODEL 129, 163, 202, 203, 208, 209, 210, 211, 215, 220, 230

Shown on engine 112



1 Copper-plated strap
2 Locating plate for right camshaft
4 Marking on right camshaft sprocket
5 Marking on left camshaft sprocket
6 Groove of camshaft

Fig. 62: Identifying Basic Position Of Camshafts - Shown On Engine 112

Modification notes

26.11.97	M112/113 Operation note modified	Step 3	**AR05.10-P-7800C**

	Removing		
1	Remove cylinder head covers	Air filter located at vehicle side. Air filter located on engine side.	**AR01.20-P-5014B** **AR01.20-P-5014BV**
2	Check basic position of camshafts	If the basic position of the camshafts is not correct: ? Turn engine to 40° after ignition TDC at cylinder 1. The engine must not be turned back; otherwise the timing chain can get jammed.	**AR05.10-P-6858V**
3	Remove chain tensioner	Engine 112 in models 211.080/082/261/ 265/280/282, Engine 113 in model 211.083/270/283 Engine 112.945 in model 463.209/232/ 233/244/245/250, Engine 112 in models 163, 129, Engine 113.962 in model 463.206/240/241 /247/248/249/254, Engine 113 (except 113.965/981) in Model 210, 208, 202, 163, 129,	**AR05.10-P-7800C**

		Engine 113.982 in model 463.243/246 Engine 112 in Model 170, 202, 203, 208, 209, 210, Engine 113 in models 163.174/175, 209 Engine 112 in Model 211.061 /065, 220, 230.467, Engine 113 in models 211.070/076/276, 215.373/374/375,220.070/073/074/075 /083/084/170/173/174/175/183/184/875, 230.474/475	**AR05.10-P-7800CA** AR05.10-P-7800AM
4	Remove camshaft Hall sensor	Engine 112 in models 211.080/082/261/265 /280/282, Engine 113 in model 211.083/270/283 Engine 112.945 in model 463.209/232/233 /244/245/250, Engine 112 in Model 129, 163, 170, 202, 203, 208, 209.361/365/461/465, 210, 211.061 /065, 220, 230.467, Engine 113 (except 113.990/991) in Model 129, 163, 202, 208, 209.375/376/475/476, 210, 211.070, 215, 220, 230.474/475, Engine 113.962 in model 463.206/240/241 /247/248/249/254, Engine 113.982 in model 463.243/246 Engine 113.990 in model 211.076/276, Engine 113.991 in models 215.374, 220.074 /174	**AR15.10-P-2000A** AR15.10-P-2000RVK
5	Remove right-hand camshaft sprocket	Lift timing chain from camshaft sprocket. Open-end wrench Insertion tool Torque wrench	**Fig. 22** **Fig. 66** **Fig. 23**
6	Remove left-hand camshaft sprocket	Lift timing chain from camshaft sprocket. Open-end wrench Insertion tool Torque wrench	**Fig. 22** **Fig. 66** **Fig. 23**
i	**Install**		
7	Rotate left-hand camshaft to the basic position and fit locating plate to the	Open-end wrench Groove of camshaft (6) must point to the center of the cylinder head cover separating surface in direction of inner V. Locating plate Place locating plate flush onto left cylinder head and insert into the groove (6) of the camshaft. At a 40° crank angle after ignition TDC of cylinder 1 it is possible to rotate	**Fig. 22** **Fig. 12**

	camshaft	the camshaft without the valves coming into contact with the pistons.	
8	Rotate right camshaft in basic position and insert locating plate for right camshaft (2) in the camshaft	Open-end wrench Groove of camshaft (6) must point to the center of the cylinder head cover separating surface in direction of inner V. Locating plate Place locating plate for right camshaft (2) flush onto the right cylinder head and insert into the groove of the camshaft (6). At a 40° crank angle after ignition TDC of cylinder 1 it is possible to rotate the camshaft without the valves coming into contact with the pistons.	**Fig. 22** **Fig. 11**
9	Install left-hand camshaft sprocket	Place timing chain onto camshaft sprocket. Insertion tool Bolt of camshaft sprocket engine 112, 113 except 113.969 AH	**Fig. 66** ***BA05.20-P-1001-01B**
10	Install right-hand camshaft sprocket	Place timing chain onto camshaft sprocket. Insertion tool Bolt of camshaft sprocket engine 112, 113 except 113.969 AH	**Fig. 66** ***BA05.20-P-1001-01B**
11	Install camshaft Hall sensor	Engine 112 in models 211.080/082/261/265 /280/282, Engine 113 in model 211.083/270/283 Engine 112.945 in model 463.209/232/233 /244/245/250, Engine 112 in Model 129, 163, 170, 202, 203, 208, 209.361/365/461/465, 210, 211.061 /065, 220, 230.467, Engine 113 (except 113.990/991) in Model 129, 163, 202, 208, 209.375/376/475/476, 210, 211.070, 215, 220, 230.474/475, Engine 113.962 in model 463.206/240/241 /247/248/249/254, Engine 113.982 in model 463.243/246 Engine 113.990 in model 211.076/276, Engine 113.991 in models 215.374, 220.074 /174 AH	**AR15.10-P-2000A** AR15.10-P-2000RVK ***BA15.10-P-1002-03A**
12	Installing chain	Engine 112 in models 211.080/082/261/265 /280/282, Engine 113 in model 211.083/270/283	

	tensioner	Engine 112.945 in model 463.209/232/233 /244/245/250, Engine 112 in models 163, 129 Engine 113.962 in model 463.206/240/241 /247/248/249/254, Engine 113 (except 113.965/981) in Model 210, 208, 202, 163, 129, Engine 113.982 in model 463.243/246	**AR05.10-P-7800C**
		Engine 112 in Model 170, 202, 203, 208, 209, 210, Engine 113 in models 163.174/175, 209	**AR05.10-P-7800CA**
		Engine 112 in Model 211.061 /065, 220, 230.467, Engine 113 in models 211.070/076/276, 215.373/374/375,220.070/073/074/075 /083/084/170/173/174/175/183/184/875, 230.474/475	AR05.10-P-7800AM
	Check		
13	Inspect timing		**AR05.10-P-6858V**
	Check general notes on valve timing, scribe marks	Engine 112, 113 The engine must not be turned back; otherwise the timing chain can get jammed.	**AH05.10-P-1000-01A**
14	Install cylinder head covers	Air filter located at vehicle side.	**AR01.20-P-5014B**
		Air filter located on engine side.	**AR01.20-P-5014BV**

AH Camshaft

Number	Designation				Engines 113.940/941/942/943/944/948/961/962/963/964/965/966/967/968/969/971/980/981/982/984/986/992/995	Engine 112 except 112.951/976
BA05.20-P-1001-01B	Bolt, camshaft sprocket	M12x45	Stage 1	Nm	50	50
			Stage 2	Angle°	90	90

AH Camshaft

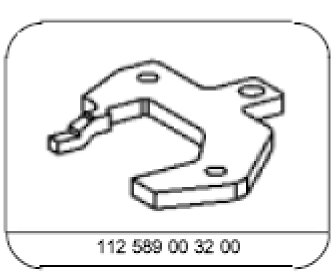
Number	Designation				Engine 112.951/976	Engine 113.960 with code 479
BA05.20-P-1001-01B	Bolt, camshaft sprocket	M1x245	Stage 1	Nm	50	50
			Stage 2	Angle°	90	90

Camshaft

Number	Designation				Engine 113.987/988/990/993	Engine 113.987/988/1
BA05.20-P-1001-01B	Bolt, camshaft sprocket	M12x45	Stage 1	Nm	50	50
			Stage 2	Angle°	90	90

Position sensor

Number	Designation		Engines 112.910/911/912/913/914/915/916/917/920/921/922/923/940/941/942/943/944/945/946/947/949/951/953/954/955/960/961/970/972/973/975/976	Engines 113.940/941/942/943/944/948/960/961/962/963/964/965/966/967/968/969/971/980/981/982/984/986/992/993/995	Engines 113.987/988/990/991
BA15.10-P-1002-03A	Camshaft Hall sensor to cylinder head	Nm	8	8	8



Locating plate

Fig. 63: Identifying Locating Plate (112 589 00 32 00)

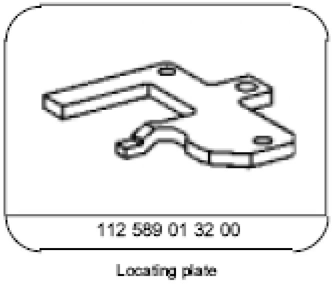


Fig. 64: Identifying Locating Plate (112 589 01 32 00)

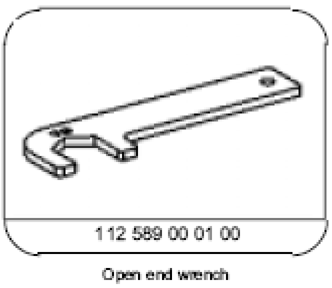


Fig. 65: Identifying Open End Wrench (112 589 00 01 00)

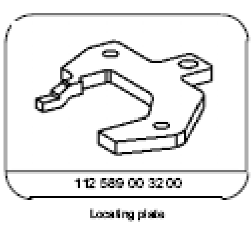


Fig. 66: Identifying Insertion Tool (112 589 01 03 00)

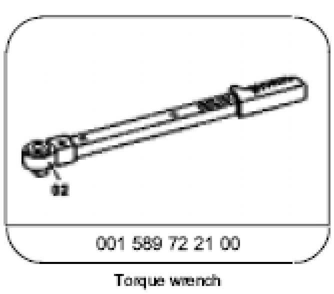


Fig. 67: Identifying Torque Wrench (001 589 72 21 00)

REMOVE/INSTALL CAMSHAFTS - AR05.20-P-6992AU

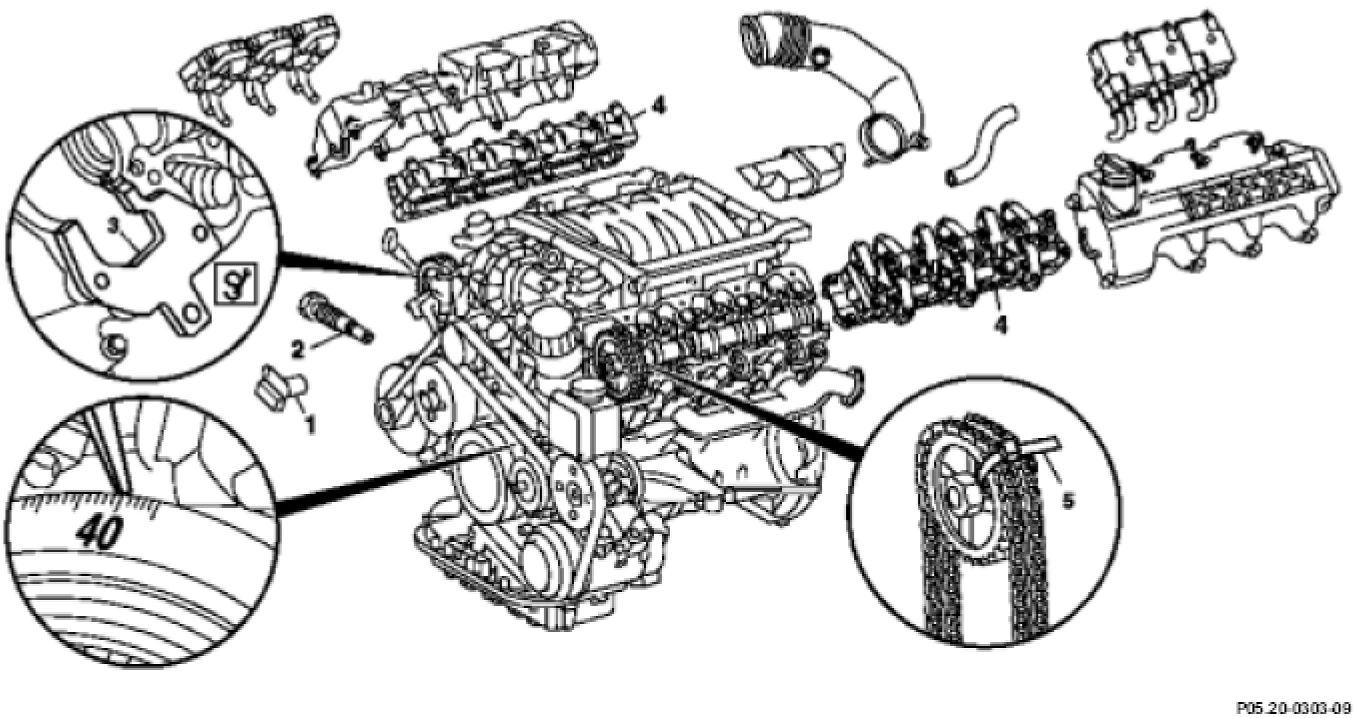
ENGINE 112

ENGINE 112.945 in MODELS 463.209 /232 /233 /244 /245 /250

ENGINE 113.962 in MODELS 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243/246

ENGINE 113 in MODELS 129, 163, 202, 203, 208, 209, 210, 211, 215, 220, 230



1	Camshaft Hall sensor	3	Right-hand camshaft locating plate 40° after first ignition TDC
2	Chain tensioner	4	Camshaft bearing bridge
		5	Cable tie

Fig. 68: Identifying Camshaft Components - Shown On Engine 112

Shown on engine 112

Modification notes

18.6.97	M112: Procedure modified, new special tool.	Step 1-14	**Fig. 66**

ⓘ	**Removing**		
1	Remove cylinder head covers	Air filter mounted on vehicle Air filter mounted on engine	**AR01.20-P-5014B** **AR01.20-P-5014BV**
2	Position piston of cylinder 1 at 40° after TDC	Rotate engine at crankshaft in direction of rotation until 40° marking on belt pulley/ vibration damper is aligned with marking on timing case cover. The	**AR05.10-P-6858V**

		grooves on the camshafts must be pointing toward the inner V. Engine must not be rotated backwards.	
3	Remove chain tensioner (2)	Model 129, 463 Model 163 except 163.174 /175 Model 202, 208, 210 with engine 113	**AR05.10-P-7800C**
		Model 170, 202, 203, 208, 209, 210 with engine 112 Model 163.174/175 Model 209.375 /475 Model 209.376 /476 up to 23.4.04	**AR05.10-P-7800CA**
		Model 203 with engine 113 Model 209.376/ 476 as of 24.4.04 Model 211.0 with engine 112, 113 Model 211.276 Model 215 Model 220, 230 with engine 112, 113 Model 211.2 except 211.276 with engine 112, 113 Model 171 with engine 113	AR05.10-P-7800AC
4	Remove camshaft Hall sensor (1)	Model 129, 163, 170, 202, 203, 208, 209, 210, 215, 220 with engine 112 Model 129, 163, 202, 208, 210 with engine 113 except engine 113.990 /991 Model 209 except 209.475 Model 211 except 211.076 /261 /265 /270 /276 Model 463 with engine 113.962 Model 463 with engine 113.982	**AR15.10-P-2000A**
		Model 211.076/276 Model 215.374, 220.074 /174	AR15.10-P-2000RVK
		Model 203 with engine 113	AR15.10-P-2000AC

		Model 171 Model 209.475 Model 211.261 /265/270	
5	Detach camshaft sprocket, take off	Tie camshaft sprocket and timing chain together with cable tie (5). Open-end wrench Insertion tool Torque wrench	 **Fig. 22** **Fig. 66** **Fig. 23**
6	Take off camshaft bearing bridge (4)	Observe slackening diagram! Engine 112, 113 except cylinder shutoff, code 479. Engine 113.960 with cylinder shutoff, code 479.	 **AR05.20-P-7103AU** AR05.20-P-7103AV
7	Remove camshaft		
i	Install		
8	Install camshaft	Pay attention to camshaft marking when installing camshaft.	
	Camshaft code number and assignment	Engine 112, 113 Oil the bearing surfaces! Pay attention to correct position of cap on front end of camshaft.	**AH05.20-N-0100-01A**
9	Install camshaft bearing bridge (4).	Observe tightening procedure. Engine 112, 113 except cylinder shutoff, code 479. Engine 113.960 with cylinder shutoff, code 479.	 **AR05.20-P-7103AU** AR05.20-P-7103AV
10	Rotate camshaft to basic position	 Locating plate Locating plate Open-end wrench	**AR05.20-P-6020AU** **Fig. 11** **Fig. 12** **Fig. 22**
11	Install camshaft sprocket	Take off cable tie (5)! AH Open-end wrench	 ***BA05.20-P-1001-01B** **Fig. 22**
12	Install camshaft Hall sensor (1)	Model 129, 163, 170, 202, 203, 208, 209, 210, 215, 220 with engine 112 Model 129, 163, 202, 208, 210 with engine 113 except	**AR15.10-P-2000A**

		engine 113.990 /991 Model 209 except 209.475 Model 211 except 211.076 /261 /265 /270 /276 Model 463 with engine 113.962 Model 463 with engine 113.982	
		Model 211.076/276 Model 215.374, 220.074 /174	AR15.10-P-2000RVK
		Model 203 with engine 113 Model 171 Model 209.475 Model 211.261 /265/270	AR15.10-P-2000AC
		AH	***BA15.10-P-1002-03A**
13	Install chain tensioner (2)	Model 129, 463 Model 163 except 163.174/175 Model 202, 208, 210 with engine 113	**AR05.10-P-7800C**
		Model 170, 202, 203, 208, 209, 210 with engine 112 Model 163.174/175 Model 209.375/475 Model 209.376/476 up to 23.4.04	**AR05.10-P-7800CA**
		Model 203 with engine 113 Model 209.376/476 as of 24.4.04	AR05.10-P-7800AC
		Model 211.0 with engine 112, 113 Model 211.276 Model 215 Model 220, 230 with engine 112, 113 Model 211.2 except 211.276 with engine 112, 113 Model 171 with engine 113	AR05.10-P-7800AM
14	Check engine valve timing		**AR05.10-P-6858V**
15	Install cylinder head covers	Air filter mounted on vehicle Air filter mounted on engine	**AR01.20-P-5014B** **AR01.20-P-5014BV**

AH Camshaft

Number	Designation				Engine 112 except 112.951/976	Engine 112.951/976
BA05.20-P-1001-01B	Bolt, camshaft sprocket	M12x45	Stage 1	Nm	50	50
			Stage 2	Angle°	90	90

Camshaft

Number	Designation				Engine 113.940/941/942/943/944/948/961/962/963/964/965/966/967/968/969/971/980/981/982/984/986/992/995
BA05.20-P-1001-01B	Bolt, camshaft sprocket	M12x45	Stage 1	Nm	50
			Stage 2	Angle°	90

Camshaft

Number	Designation				Engine 113.960 without code 479	Engine 113.960 with code 479
BA05.20-P-1001-01B	Bolt, camshaft sprocket	M12x45	Stage 1	Nm	50	50
			Stage 2	Angle°	90	90

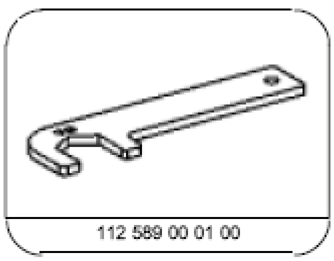
Camshaft

Number	Designation				Engine 113.987/988/990/993	Engine 113.991
BA05.20-P-1001-01B	Bolt, camshaft sprocket	M1x245	Stage 1	Nm	50	50
			Stage 2	Angle°	90	90

Position sensor

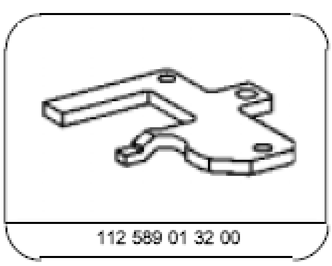
Number	Designation	Engine 112.910/911/912/913/914/915/916/917/920/921/922/923/940/941/942/943/944/945/946/947/949/951/953/	Engine 113.940/941/942/943/944/948/960/961/962/963/964/965/966/967/968/969/971/980/981/982/984/986/992/	Engine 113.987/988/990/991

		954/955/960/ 961/970/972/ 973/975/976	**993/995**	
BA15.10-P-1002-03A	Camshaft Hall sensor to cylinder head Nm	8	8	8



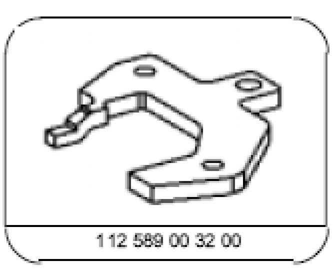
Open end wrench

Fig. 69: Identifying Open End Wrench (112 589 00 01 00)



Locating plate

Fig. 70: Identifying Locating Plate (112 589 01 32 00)



Locating plate

Fig. 71: Identifying Locating Plate (112 589 00 32 00)

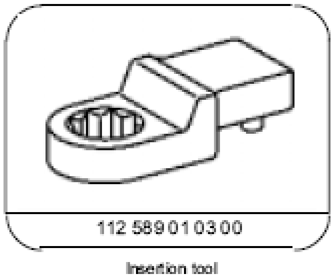


Fig. 72: Identifying Insertion Tool (112 589 01 03 00)

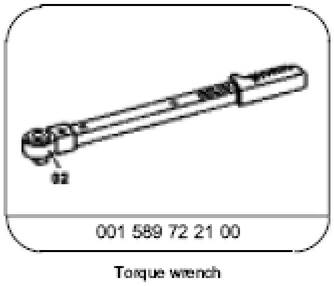


Fig. 73: Identifying Torque Wrench (001 589 72 21 00)

REMOVE/INSTALL CAMSHAFT BEARING BRIDGE - AR05.20-P-7103AU

ENGINE 113 (except 113.995) in MODEL 129, 163, 202, 203, 208, 209, 210, 211, 215, 220, 230

ENGINE 112

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243/246

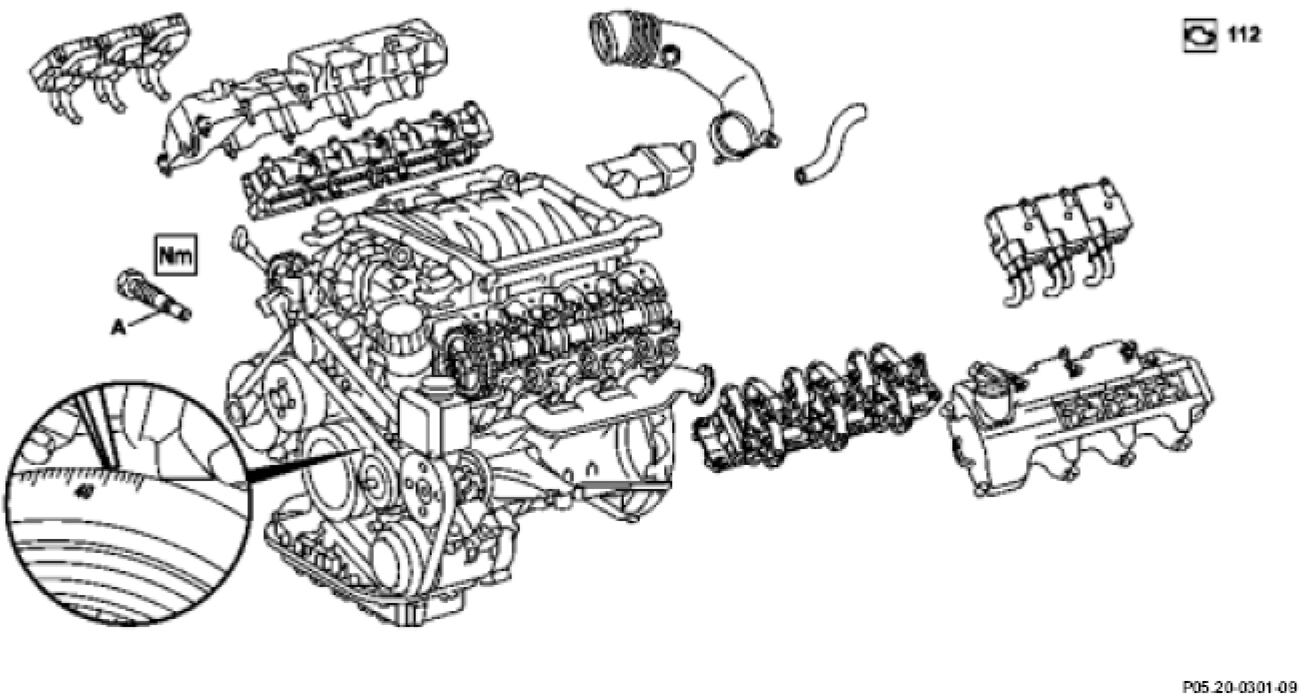


Fig. 74: Identifying Camshaft Bearing Bridge Components

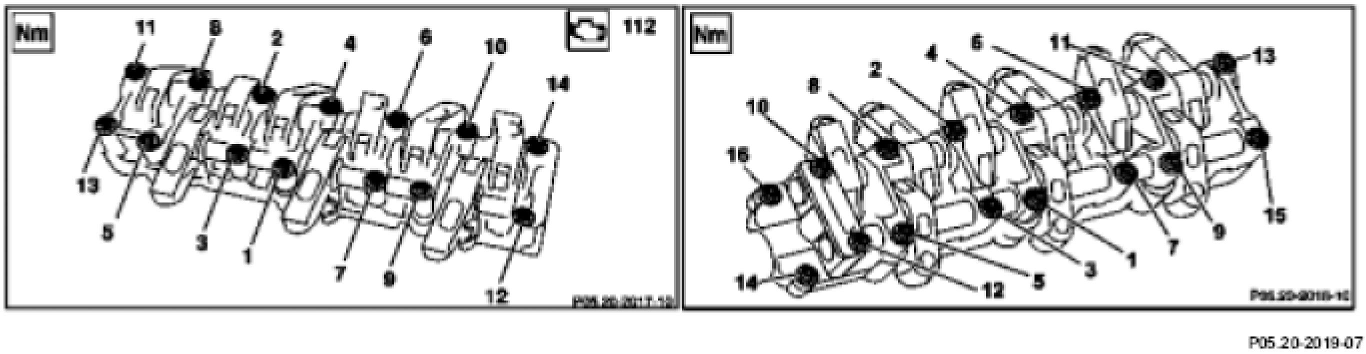


Fig. 75: Identifying Sequence Of Rocker Arm Bolts (Engine 112)

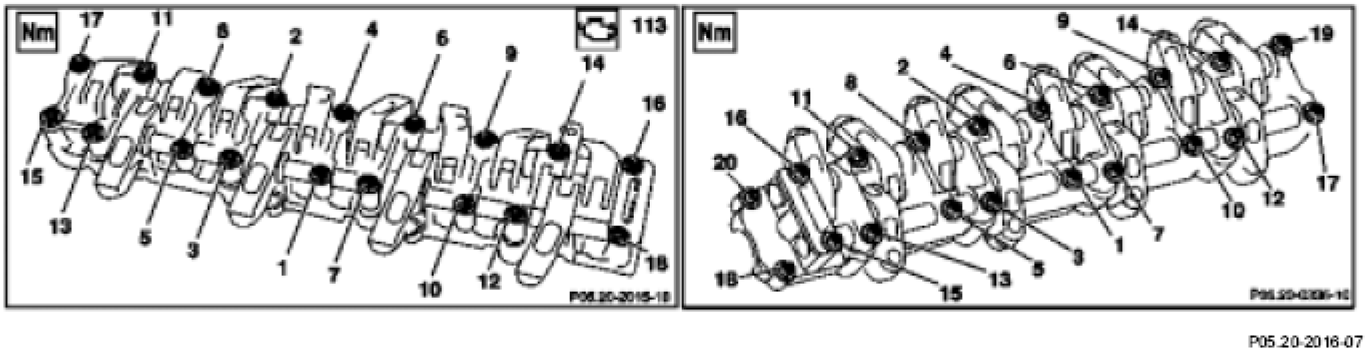


Fig. 76: Identifying Sequence Of Rocker Arm Bolts (Engine 113)

	Remove/install		
1	Remove cylinder head cover	Air filter located at vehicle side. Air filter located on engine side.	**AR01.20-P-5014B** **AR01.20-P-5014BV**
2	Position piston of cylinder 1 at 40° after TDC	Engine must not be cranked backwards. Rotate engine at crankshaft in direction of rotation until 40° marking on belt pulley/ vibration damper is aligned with marking on timing case cover. Grooves in the camshafts must point towards the "inner V".	**AR05.10-P-6858V**
3	Remove chain tensioner (A)	Engine 112 in models 211.080/082/261/265 /280/282, Engine 113 in model 211.083/270/283 Engine 112.945 in model 463.209/232/233 /244/245/250, Engine 112 in models 163, 129, Engine 113.962 in model 463.206/240/241 /247/248/249/254, Engine 113 (except 113.965/981) in models 210, 208, 202, 163, 129, Engine 113.982 in model 463.243/246 Engine 112 in models 170, 202, 203, 208, 209, 210, Engine 113 in models 163.174/175, 209 Engine 112 in models 211.061 /065, 220, 230.467, Engine 113 in models 211.070/076/276, 215.373/374/375,220.070/073/074/075 /083/084/170/173/174/175/183/184/875, 230.474/475	**AR05.10-P-7800C** **AR05.10-P-7800CA** AR05.10-P-7800AM
4	Remove camshaft bearing bridge Information on installing camshaft bearing bridge	Tie camshaft sprocket and timing chain together with a cable strap to prevent the timing chain from skipping. Slacken bolts in stages in the opposite sequence to the torquing pattern. (See diagram) Engine 112/113 except cylinder shutoff code 479 **Installation:** Bolt, camshaft bearing bridge to cylinder head, engine 112, 113 except 113.969 AH AH	**AH05.20-P-2000-01AV** ***BA05.20-P-1002-01B** ***BA05.20-P-1004-01B**
5	Install in the reverse order		

AH **Camshaft**

Number	Designation			Engine 112 except 112.951/976	Engines 112.951/ 976
BA05.20-P-	Bolt, camshaft M7x45	Stage 1	Nm	15	8

1002-01B	bearing bridge to cylinder head		Stage 2	Angle°	-	120
BA05.20-P-1004-01B	Bolt, camshaft bearing bridge to cylinder head	M7x84	Stage 1	Nm	10	8
			Stage 2	Angle°	90	120

AH Camshaft

Number	Designation				Engines 113.940/941/942/943/944/948/961/962/963/964/965/966/967/968/969/971/980/981/982/984/986/992/995
BA05.20-P-1002-01B	Bolt, camshaft bearing bridge to cylinder head	M7x45	Stage 1	Nm	15
			Stage 2	Angle°	-
BA05.20-P-1004-01B	Bolt, camshaft bearing bridge to cylinder head	M7x84	Stage 1	Nm	10
			Stage 2	Angle°	90

AH Camshaft

Number	Designation				Engine 113.987/988/990/993	Engine 113.991
BA05.20-P-1002-01B	Bolt, camshaft bearing bridge to cylinder head	M7x45	Stage 1	Nm	8	8
			Stage 2	Angle°	120	120
BA05.20-P-1004-01B	Bolt, camshaft bearing bridge to cylinder head	M7x84	Stage 1	Nm	8	8
			Stage 2	Angle°	120	120

REPLACE VALVE STEM SEALS - AR05.30-P-3500-02A

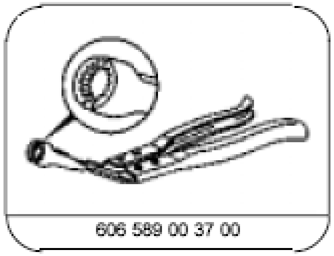


Fig. 77: Identifying Pliers (606 589 00 37 00)

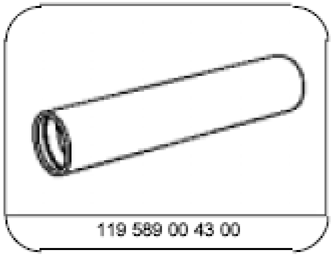


Fig. 78: Identifying Drift (119 589 00 43 00)

Engine 111, 271

Shown on engine 111

1. Use pliers (1) to pull off valve stem seals (86)
2. Check surface of valve stems for roughness and formation of burrs (visual inspection or with a nail).

   Replace valves with a rough stem surface or formation of burrs.

3. Fit protective sleeve (2) onto valve stem.
4. Oil valve stem seals (86).
5. Press on the valve stem seals (86) with a drift (3).

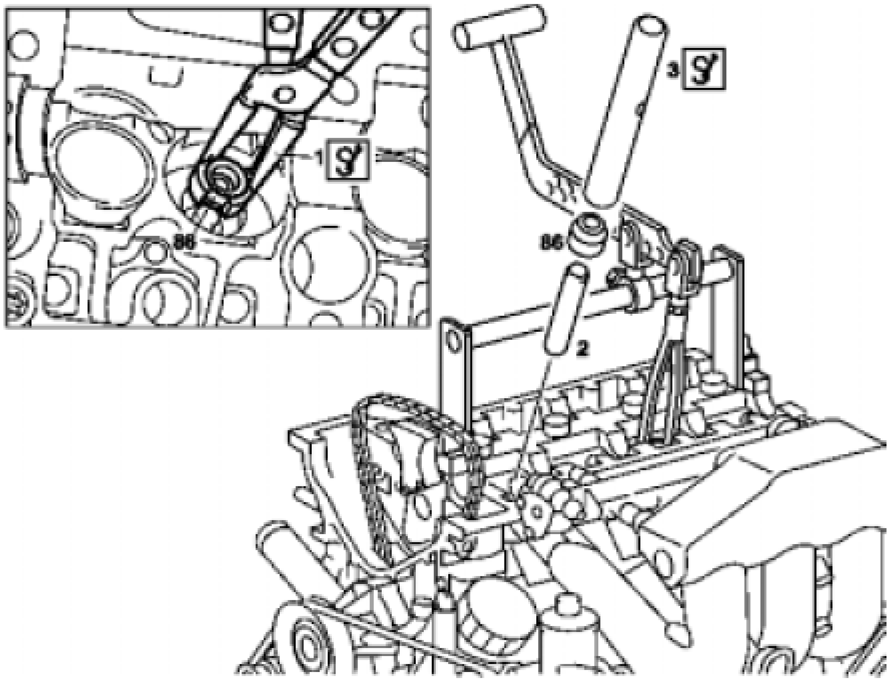


Fig. 79: Identifying Replacement Of Valve Stem Seals - Shown On Engine 111

Engines 112, 113

Shown on Engine 112

1. Use pliers (1) to pull off valve stem seals (86)
2. Check surface of valve stems for roughness and formation of burrs (visual inspection or with a nail).

   Replace valves with a rough stem surface or formation of burrs.

3. Fit protective sleeve (2) onto valve stem.
4. Oil valve stem seals (86).
5. Press on the valve stem seals (86) with a drift (3).

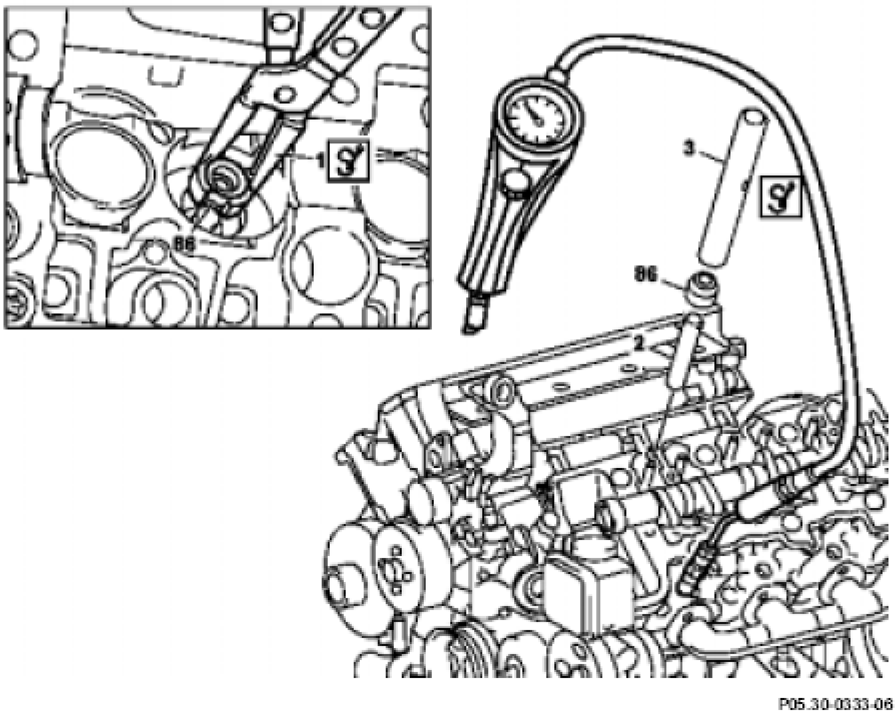


Fig. 80: Identifying Replacement Of Valve Stem Seals - Shown On Engine 112

REMOVE/INSTALL VALVE SPRINGS AND / OR VALVE STEM SEALS - AR05.30-P-3500B

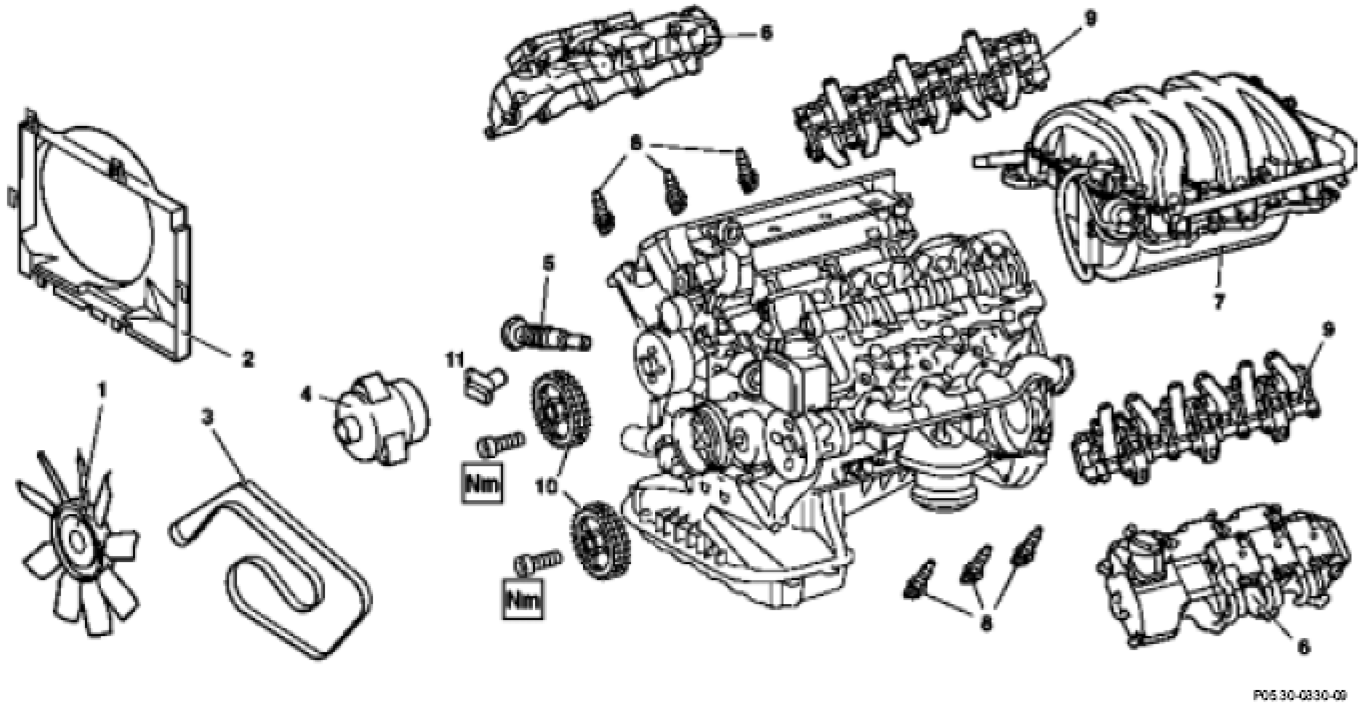
ENGINE 112.945 in MODELS 463.209 /232 /233 /244 /245 /250

ENGINE 112 in MODELS 129, 163

ENGINE 113.962 in MODELS 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113 in MODELS 129, 163, 202, 208, 210

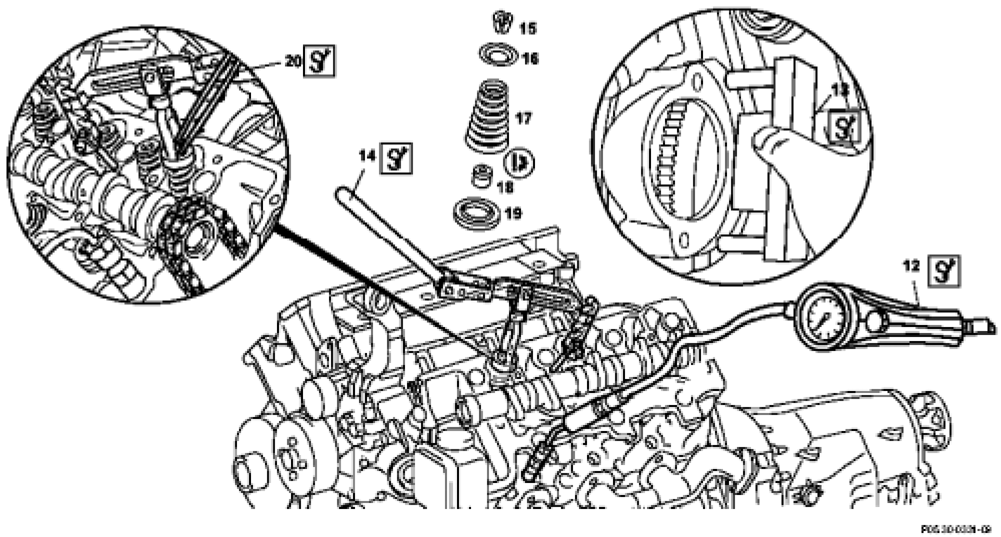
ENGINE 113.982 in MODELS 463.243 /246



		4	*Generator*	*8*	*Spark plugs*
1	*Viscous fan*	*5*	*Chain tensioner*	*9*	*Camshaft bearing bridges*
2	*Fan shroud*	*6*	*Cylinder head covers*	*10*	*Camshaft sprockets*
3	*Poly-V-belt*	*7*	*Intake manifold*	*11*	*Camshaft position sensor*

Fig. 81: Identifying Valve Springs And / Or Valve Stem Seal Components - Shown On Engine 112 In Model 129

Shown on ENGINE 112 in MODEL 129



12	Cylinder leak tester	15	Valve collets	18	Valve stem seal
13	Retaining lock	16	Upper valve spring retainer	19	Bottom valve spring retainer
14	Valve tool	17	Valve spring	20	Tweezers

Fig. 82: Identifying Valve Springs And / Or Valve Stem Seal Components - Shown On Engine 112 (1 Of 2)

Shown on engine 112

Shown on engine 112

12	Cylinder leak tester
18	Valve stem seal
21	Valve stem seal pliers
22	Assembly drift
23	Connection hose

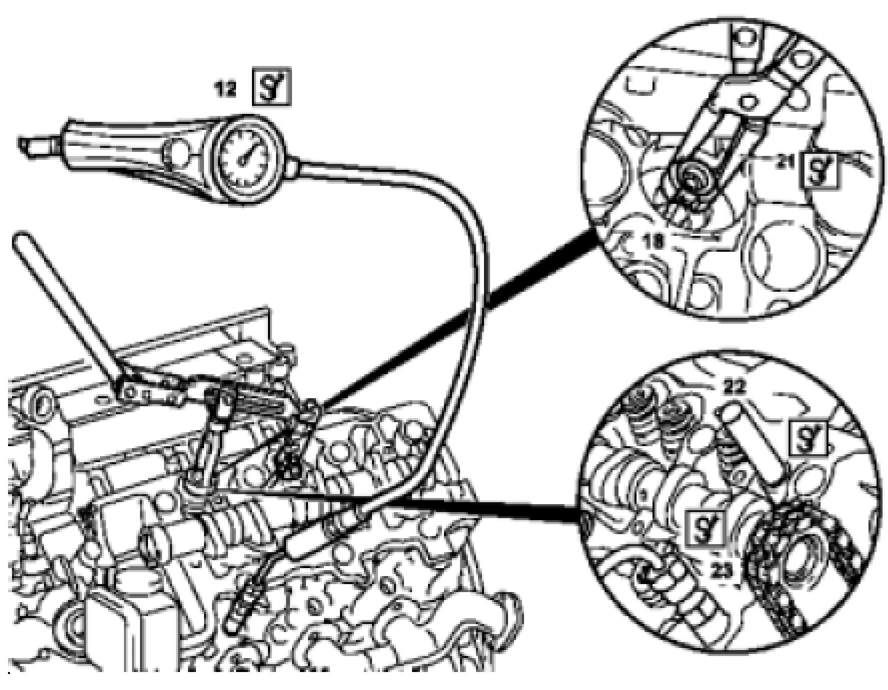


Fig. 83: Identifying Valve Springs And / Or Valve Stem Seal Components - Shown On Engine 112 (2 Of 2)

	Remove/install		
1	Remove engine cover or air filter	Remove engine trim panel or air filter by pulling it vertically up and off the cylinder head covers.	
2	Remove viscous fan (1)	Right-hand thread!	**AR20.40-P-5660C**
3	Fan shroud (2)	On model 163 unscrew bolts at bottom of fan shroud. Models 163. Model 463.	 **AR20.40-P-5000GH** AR20.40-P-6800V
4	Remove poly-V-belt (3)	**Installation:** Lock tensioning device with a drift or pin (diameter 5 mm).	**AR13.22-P-1202B**
5	Remove cylinder head covers (6)	Air filter located at vehicle side. Air filter located on engine side.	**AR01.20-P-5014B** **AR01.20-P-5014BV**
6 PE	Remove spark plugs (8)	Only one spark plug at each cylinder. Models 163. Models 129, 202, 208, 210. Model 463.	 **AP15.10-P-1580GH** AP15.10-P-1580A AP15.10-P-1580GA
7	Remove intake manifold (7)	The intake manifold system must not be disassembled. Remove intake manifold together with fuel rail. Models 129, 163, 202, 208, 210. Model 463.	 **AR09.20-P-1310A** AR09.20-P-1310AG
8	Position crankshaft to 40° after ignition TDC of cylinder 1	Engine must not be cranked back!	**AR05.10-P-6858V**
9	Remove chain tensioner (5)		**AR05.10-P-7800C**
10	Remove camshaft		**AR15.10-P-2000A**

	position sensor (11)		
11	Remove camshaft sprockets (10)	Lock right and left camshaft with locating plates. Locating plate Locating plate Open-end wrench Insertion tool Torque wrench AH After installation: ? Inspect timing of engine. ? If necessary after checking: Set basic position of camshafts.	 **Fig. 11** **Fig. 12** **Fig. 22** **Fig. 66** 001589722100 ***BA05.20-P-1001-01B** **AR05.10-P-6858V** **AR05.20-P-6020AU**
12	Remove camshaft bearing bridges (9)	Engines 112, 113 except code (479) Cylinder shutoff. Engine 113 with code (479) cylinder shutoff.	**AR05.20-P-7103AU** AR05.20-P-7103AV
13	Position piston of cylinder to be processed to TDC	Crank engine at crankshaft for this purpose and hold up timing chain (so that it does not jam). **Installation:** Before installing the camshaft sprockets, again turn back the crankshaft in the starting position to 40 ° as per ignition TDC at the first cylinder.	
14	Install retaining lock (13) for crankshaft	After setting TDC of cylinder to be processed, in order to prevent crankshaft turning further.	**AR03.30-P-5000B**
15	Connect up cylinder leak tester (12)	USA Turn connection hose of cylinder leak tester into the relevant spark plug hole.	***WH58.30-Z-1015-05A**
16	Pressurize compression chamber	With a pressure of about 5 bar.	

17	Screw retaining fork and detent with hinged bearing into cylinder head	Valve assembly tools case	**Fig. 89**
18	Attach detent depressor with lever handle and thrust piece into detent with hinged bearing, align	Position thrust piece vertically at valve spring retainer and align parallel to detent with hinged bearing. Valve assembly tools case	**Fig. 89**
19	Remove upper valve spring plate (16) and valve spring (17)	Do not allow valves to touch the piston crowns otherwise they will be bent. Compress valve spring and remove valve collets with tweezers or magnetic finger. The valve springs of the inlet and exhaust valves are identical. Magnetic finger USA Tweezers	 **Fig. 90** ***WH58.30-Z-1040-02A**
20	Replace valve stem seals (18)	Inspect surface of valve stems for roughness and formation of burrs (visual inspection or with a nail). Replace valves with a rough stem surface or formation of burrs: ? Remove valves.	**AR05.30-P-3500-02A** **AR05.30-P-3511AV**
21	Remove lower valve spring plate (19)		
	Checking		
22	Inspect top and bottom valve spring retainers (16, 19)	Inspect valve spring retainer for formation of burrs, replace if necessary.	
23	Install in the reverse order		

AH Camshaft

Number	Designation	Engine 112	Engines 113.940/941/

					except 112.951/976	**942/943/944/948/961/962/963/964/965/966/967/968/969/971/980/981/982/984/986/992/995**
BA05.20-P-1001-01B	Bolt for camshaft sprocket	M12x45	Stage 1	Nm	50	50
			Stage 2	Angle°	90	90

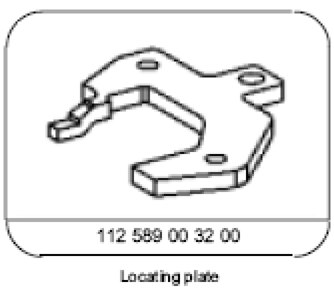


Fig. 84: Identifying Locating Plate (112 589 00 32 00)

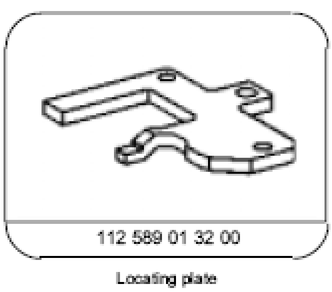


Fig. 85: Identifying Locating Plate (112 589 01 32 00)

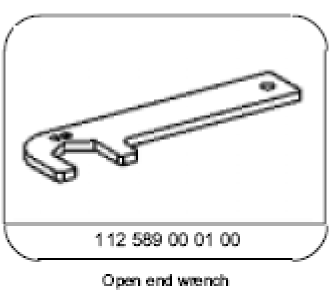
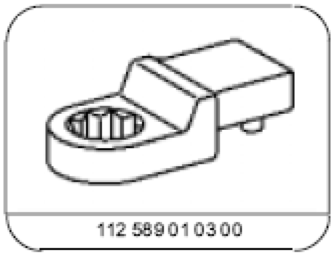
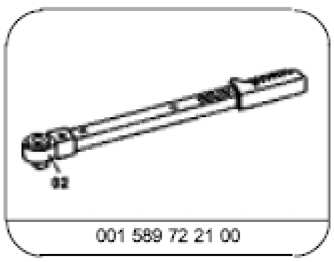


Fig. 86: Identifying Open End Wrench (112 589 00 01 00)



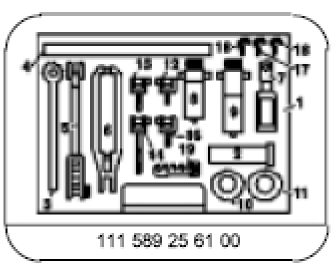
Insertion tool

Fig. 87: Identifying Insertion Tool (112 589 01 03 00)



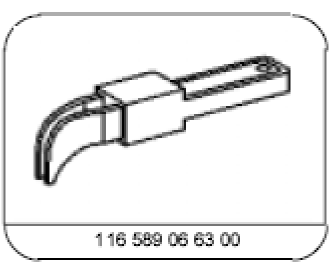
Torque wrench

Fig. 88: Identifying Torque Wrench (001 589 72 21 00)



Valve assembly tool case

Fig. 89: Identifying Valve Assembly Tool Case (111 589 25 61 00)



Magnet finger

Fig. 90: Identifying Magnet Finger (116 589 06 63 00)

Commercially available tools

Number	Designation
WH58.30-Z-1040-02A	Tweezers, straight 160 mm with rounded tips

WH58.30-Z-1015-05A	Cylinder leakage testing unit

REMOVE/INSTALL VALVES - AR05.30-P-3511AV

ENGINE 112 in MODEL 129, 163, 170, 202, 203, 208, 209, 210, 220

ENGINE 113 in MODEL 129, 163, 202, 203, 208, 209, 210, 211.076/276, 215.373/374/375, 220, 230.474/475

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

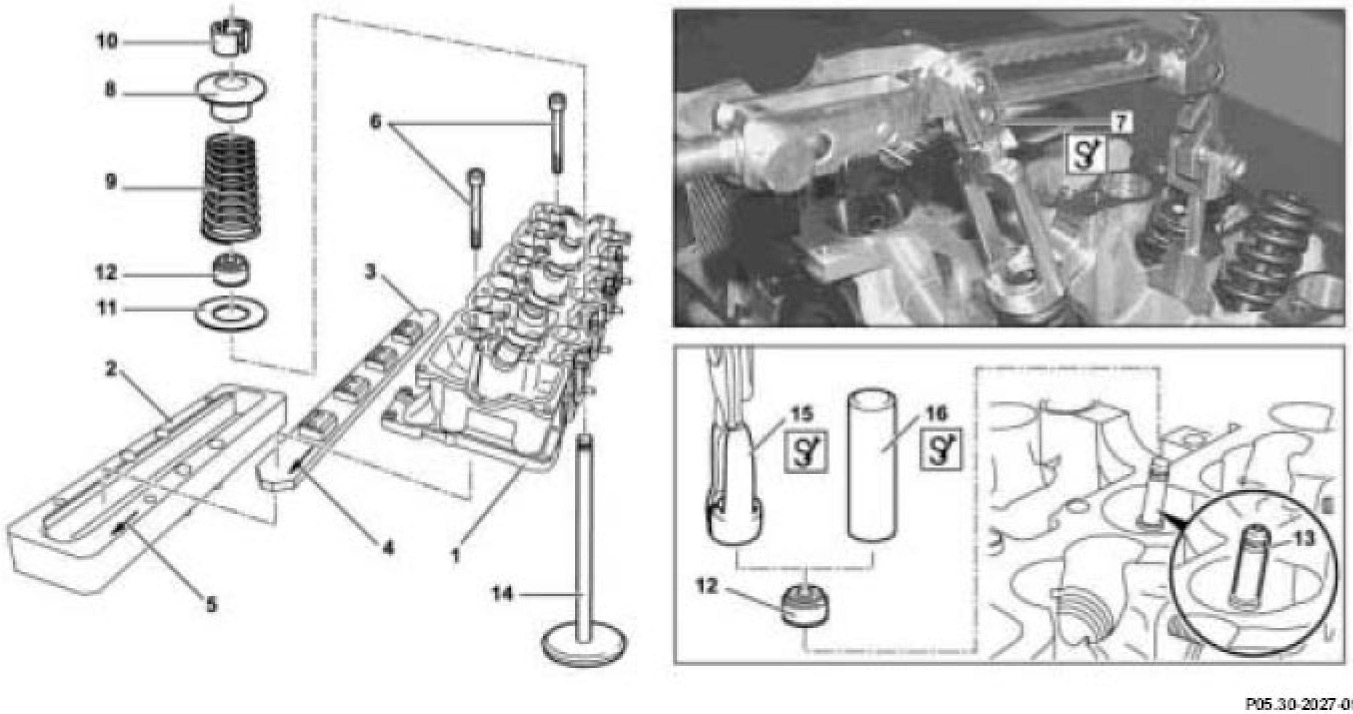
ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243/246

ENGINE 112.913 in MODEL 211.061/261

ENGINE 112.949 in MODEL 211.065/265

ENGINE 113.967 in MODEL 211.070/270



1	*Cylinder head*	*9*	*Valve spring*
2	*Assembly board*	*10*	*Valve collets*
3	*Insertion plate*	*11*	*Valve disk (bottom)*
4	*Direction of travel arrow (insertion plate)*	*12*	*Valve stem seal*
5	*Direction of travel arrow (assembly board)*	*13*	*Protective sleeve for valve stem seal*
6	*Bolts*	*14*	*Valve*
7	*Assembly tool (valves)*	*15*	*Pliers*
8	*Valve disk (top)*	*16*	*Drift*

Fig. 91: Identifying Valve Components

i	**Remove/install**		
Nm	**Risk of death** caused by vehicle slipping or toppling off the lifting platform.	Align vehicle between columns of vehicle lift and position four support plates at vehicle lift support points specified by vehicle manufacturer.	**AS00.00-Z-0010-01A**
1	Remove cylinder head (1)	Model 163.154/157/172/174/175	**AR01.30-P-5800MV**
		Model 129 with engine 112, 113 Model 202, 208, 210 with engine 113	AR01.30-P-5800B
		Model 170, 202, 208, 210, 220 with engine 112 Model 211.076/276, 215.374, 220, 230.474/475 with engine 113	AR01.30-P-5800BA
		Model 203 except 203.764, 209, 211	AR01.30-P-5800PV
		Model 463.2 with engine 112, 113 Model 203.764	AR01.30-P-5800GV

		Model 215.373/375	
2	Mount cylinder head (1) onto the assembly board (2) with the associated insertion plate (3)	Insert insertion plate (3) with arrow indicating the direction of travel (insertion plate) (4) pointing to the front and, according to the cylinder head, for the right or left side into the assembly board (2). i004 Mount cylinder head (1)with its front end pointing to the arrow indicating the direction of travel (assembly board) (5) with one bolt (6) each at the front and rear onto the assembly board (2). The cylinder head (1) can be mounted on the assembly board (2) without removing the exhaust manifold. Assembly board	**Fig. 92**
3	Attach assembly tool (valves) (7) to cylinder head (1) and position vertically at the valve disk (top) (8)	Use parts 2, 3, 4, 5, 7, 14, 19 from the valve assembly tool case (valves) (7). Valve assembly tools case	**Fig. 89**
4	Remove valve disk (upper) (8) and valve disk (lower) (11)	Press valve spring (9) together with assembly tool (valves) (7), remove split valve spring retainer locks (10) Check valve disk (top) (8) and valve disk (bottom) (11) for formation of burrs, replace if necessary. The valve springs (9) of the inlet valves and exhaust valves are identical. Magnetic pin Magnetic finger	**Fig. 95** **Fig. 90**
5	Use pliers (15) to remove valve stem seals (12)	**Installation:** Fit protective sleeve for valve stem seal (13) onto valve stem. Oil valve stem seal (12) and press on with drift (16). The protective sleeve for the valve stem seal (13) must be removed from the valve stem after pressing on the valve stem seal (12). Pliers	**Fig. 77**

		Drift	**Fig. 78**
6	Remove cylinder head (1) from assembly board (2)		
Nm	**Risk of explosion and poisoning** caused by the melting down or improper handling of sodium-filled valves. **Risk of injury** caused by skin contact with sodium resulting in heat or chemical burns.	Do not open sodium-filled valves. Wear protective gloves and safety glasses when handling damaged valves.	**AS05.30-Z-0001-01A**
7	Remove valve (14)	**Installation:** Check surface of valve stems for roughness and formation of ridging (visual inspection or with a nail). Replace valves (14) with a rough stem surface or formation of burrs. Grind new or reused valves (14) with valve grinding compound before installation.	
	Disposal of sodium-filled valves	Exhaust valves with sodium filling	OS05.30-P-0001-01A
	Checking		
8	Check valves (14)	Intake and exhaust valves must not be machined. If the specified tolerances are below the required limit, the valve (14) must be replaced to ensure functioning.	**AR05.30-P-4201-01AV**
		Valve disk ø	***BE05.30-P-1001-01E**
		Valve disk height	***BE05.30-P-1002-01E**
		Valve seat angle (a)	***BE05.30-P-1003-01E**
		Valve stem ø	***BE05.30-P-1004-01E**
		Valve length	***BE05.30-P-1005-01E**
9	Inspect valve guides, replace if necessary		**AR05.30-P-3731AV**
10	Install in the reverse		

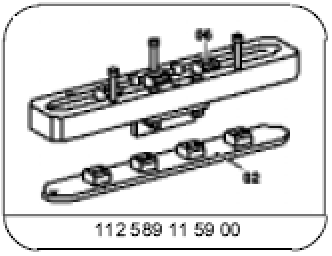
	order		

Check values for valves

Number	Designation			Engine 113.940/941/ 942/943/944	Engine 113.960/ 961/962/963/ 965/967/968/ 980/981/982/ 984/987/988/ 990/991/992/ 993/995
BE05.30-P-1001-01E	Valve disk ø	Exhaust	mm	41 ±0.1	43±0.1
		Intake	mm	36±0.1	38±0.1
BE05.30-P-1002-01E	Valve disk height	Exhaust when new	mm	1.6	1.6
		Intake when new	mm	1.2	1.2
BE05.30-P-1003-01E	Valve seat angle	(a Exhaust)	Angle°	45±15'	45±15'
		Intake	Angle°	45°15'	45±15'
BE05.30-P-1004-01E	Valve stem ø	Exhaust	mm	6.970	6.970
		Intake	mm	6.975	6.975
BE05.30-P-1005-01E	Valve length	Exhaust	mm	122.25±0.2	121.80±0.2
		Intake	mm	119.40±0.2	119.10±0.2

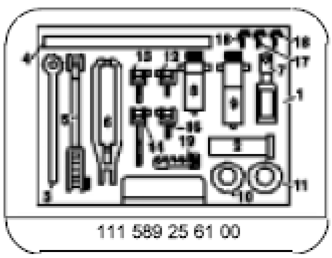
Check values for valves

Number	Designation			Engine 112.910/911	Engine 112.912/913/ 914/915/920/ 921/922/923/ 940/941/942/ 943/944/945/ 946/947/948/ 949/960
BE05.30-P-1001-01E	Valve disk ø	Exhaust	mm	34±0.1	41±0.1
		Intake	mm	30±0.1	36±0.1
BE05.30-P-1002-01E	Valve disk height	Exhaust when new	mm	1.6	1.6
		Intake when new	mm	1.2	1.2
BE05.30-P-1003-01E	Valve seat angle (a)	Exhaust	Angle°	45 (+15')	45 (+15')
		Intake	Angle°	45 (+15')	45 (+15')
BE05.30-P-1004-01E	Valve stem ø	Exhaust	mm	6.970	6.970
		Intake	mm	6.975	6.975
BE05.30-P-1005-01E	Valve length	Exhaust	mm	121.65±0.2	122.25±
		Intake	mm	120.70±0.2	119.40±0.2



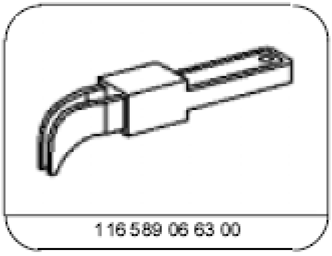
Assembly board

Fig. 92: Identifying Assembly Board (112 589 11 59 00)



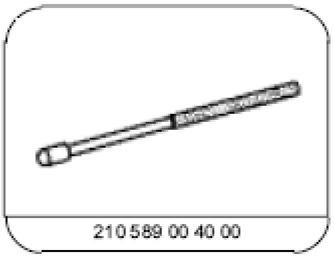
Case for valve installation tools

Fig. 93: Identifying Case For Valve Installation Tools (111 589 25 61 00)



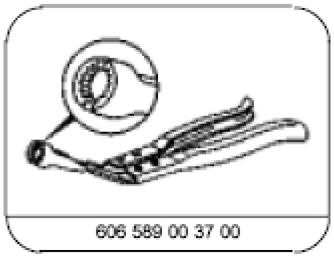
Magnetic finger

Fig. 94: Identifying Magnetic Finger (116 589 06 63 00)



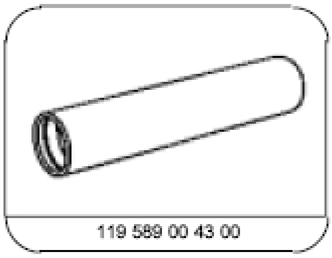
Magnetic pin

Fig. 95: Identifying Magnetic Pin (210 589 00 40 00)



Pliers

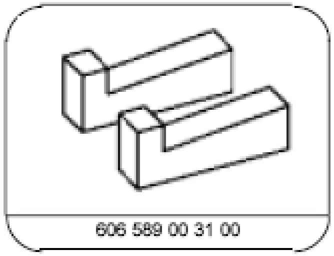
Fig. 96: Identifying Pliers (606 589 00 37 00)



Drift

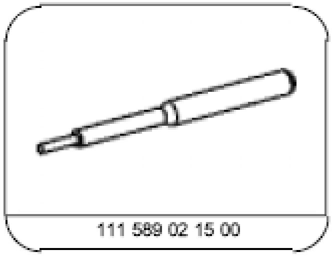
Fig. 97: Identifying Drift (119 589 00 43 00)

KNOCKING OUT VALVE GUIDE - AR05.30-P-3731-01AV



Supports (1 pair)

Fig. 98: Identifying Supports (1 Pair) (606 589 00 31 00)



Drift

Fig. 99: Identifying Drift (11 589 02 15 00)

1. Place the cylinder head on both the ◁ supports (1). Align the ◁ supports (1) so that the valve guide

to be knocked out cannot hit the supports (1).

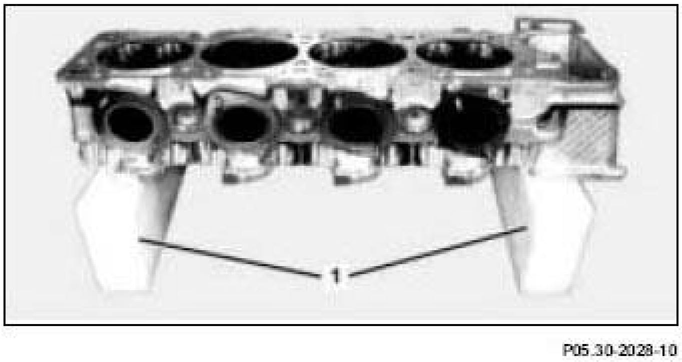


Fig. 100: Identifying Cylinder Head Support

2. Knock out the valve guide (2) from the side of the combustion chamber using a drift (3)

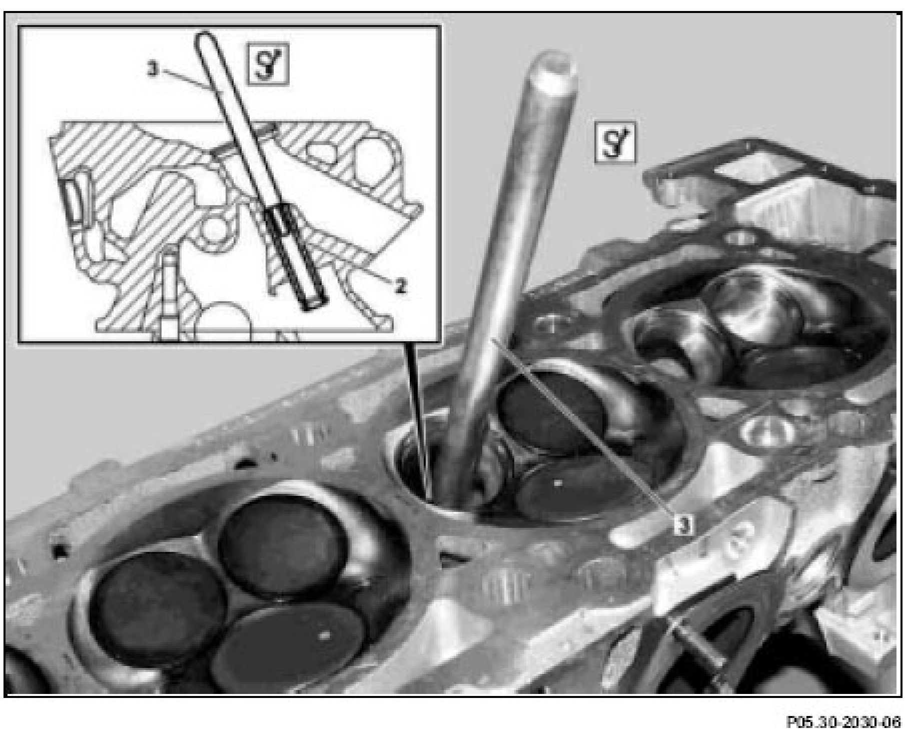


Fig. 101: Identifying Knock Out Valve Guide From Side Of Combustion Chamber

INSERT VALVE GUIDE, INSPECT - AR05.30-P-3731-03AV

Test and adjustment values for valve guides

Number	Designation	Engine 112 except 112.951/976, Engines 113.940/941/ 942/943/944/	Engines 112.951/976

				945/946/948/ 960/961/962/ 963/964/965/ 966/967/968/ 969/971/980/ 981/982/984/ 986/987/988/ 990/991/992/ 993/995	
BE05.30-P-1001-02D	Outside diameter of exhaust and intake valve guide	Standard series	mm	12.540...12.551	12.540...12.551
		Standard I series (color: blue)	mm	12.560...12.571	12.560...12.571
		Repair stage I (color: red)	mm	12.740...12.751	12.740...12.751
		Repair stage II (color: yellow)	mm	13.140...13.151	13.140...13.151
BE05.30-P-1002-02D	Bore diameter in cylinder head of exhaust and intake valve guide	Standard series	mm	12.500...12.511	12.500...12.511
		Standard I series (color: blue)	mm	12.520...12.531	12.520...12.531
		Repair stage I (color: red)	mm	12.700...12.711	12.700...12.711
		Repair stage II (color: yellow)	mm	13.100...13.11113.100...13.1	13.100...13.11113.100...13.1
BE05.30-P-1003-02D	Overlap in cylinder head		mm	0.029...0.051	0.029...0.051
BE05.30-P-1004-02D	Length	L	mm	50	50
BE05.30-P-1005-02D	Dimension	A	mm	14.3 (±0.2)	14.3 (±0.2)

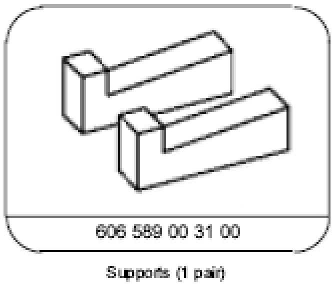


Fig. 102: Identifying Supports (1 Pair) (606 589 00 31 00)

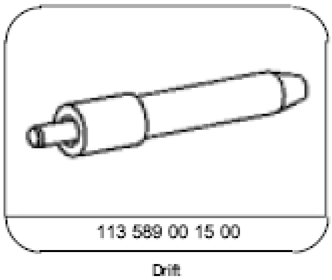


Fig. 103: Identifying Drift (113 589 00 15 00)



Fig. 104: Identifying Feeler Gauge (102 589 01 23 00)

1. Place cylinder head onto the ◁ supports (1).

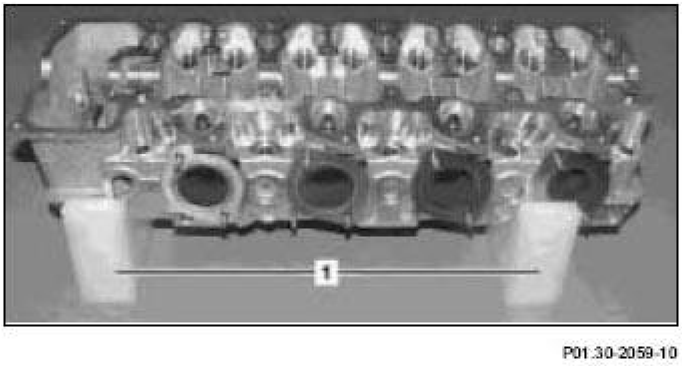
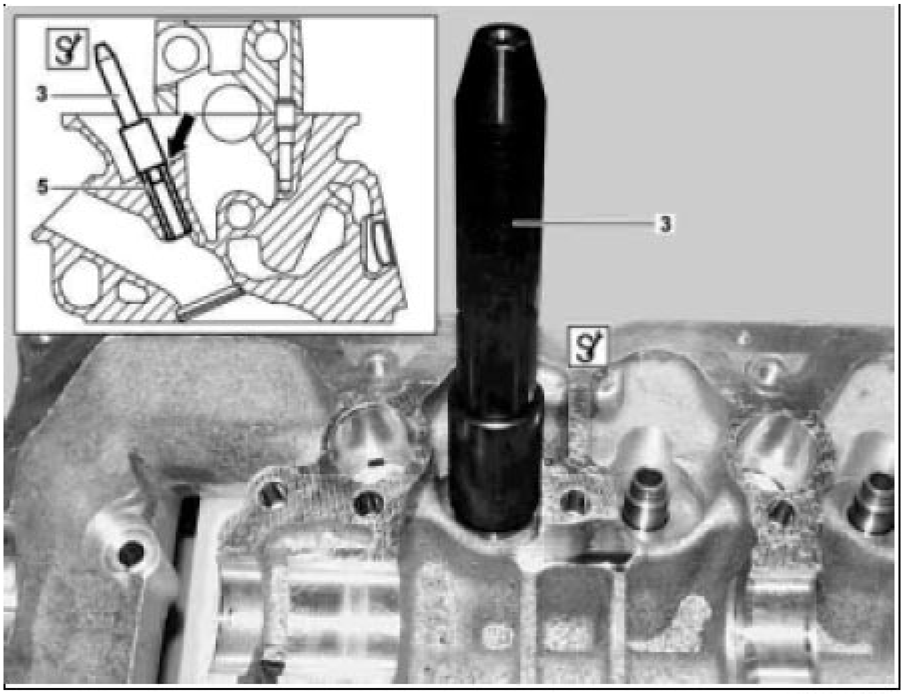


Fig. 105: Identifying Cylinder Head Supports

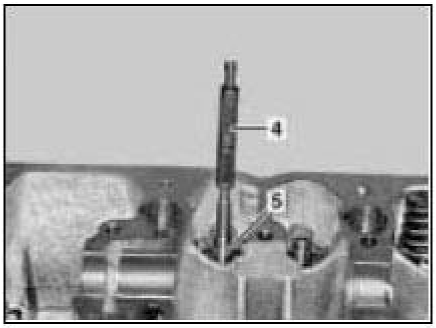
2. Coat the outside of valve guide (5) with oil.
3. Position the valve guide (5) and knock into the cylinder head as far as the stop (arrow) of the insertion drift (3). Check the secure seating of the valve guide (5). The installation depth of the valve guide (5) is set by the drift punch (3).



P05.30-2031-06

Fig. 106: Identifying Valve Guide

4. Check the valve guide (5) with the feeler gauge (4). The side of the feeler gauge (4) marked with '0' must be inserted completely into the valve guide (5). The valve guide (5) must be replaced if the feeler gauge (4) cannot be inserted completely. The valve guide (5) is made of powdered metal, so reaming is not possible.



P05.30-2098-01

Fig. 107: Identifying Valve Guide And Feeler Gauge

REAM BASIC BORE TO REPAIR STAGE I - AR05.30-P-3731-04AV

Test and adjustment values for valve guides

Number	Designation			Engine 112 except 112.951/976, Engines 113.940/941/ 942/943/944/ 945/946/948/ 960/961/962/ 963/964/965/ 966/967/968/ 969/971/980/ 981/982/984/ 986/987/988/ 990/991/992/ 993/995	Engine 112.951/976
BE05.30-P-1001-02D	Outside diameter of exhaust and intake valve guide	Standard series	mm	12.540...12.551	12.540...12.551
		Standard I series (color: blue)	mm	12.560...12.571	12.560...12.571
		Repair stage I (color: red)	mm	12.740...12.751	12.740...12.751
		Repair stage II (color: yellow)	mm	13.140...13.151	13.140...13.151
BE05.30-P-1002-02D	Bore diameter in cylinder head of exhaust and intake valve guide	Standard series	mm	12.500...12.511	12.500...12.511
		Standard I series (color: blue)	mm	12.520...12.531	12.520...12.531
		Repair stage I (color: red)	mm	12.700...12.711	12.700...12.711
		Repair stage II (color: yellow)	mm	13.100...13.11113.100...13.1	13.100...13.11113.100...13.1
BE05.30-P-1003-02D	Overlap in cylinder head		mm	0.029...0.051	0.029...0.051
BE05.30-P-1004-02D	Length	L	mm	50	50

BE05.30-P-1005-02D	Dimension	A	mm	14.3 (±0.2)	14.3 (±0.2)

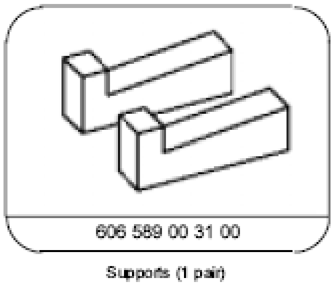


Fig. 108: Identifying Supports(1 Pair) (606 589 00 31 00)

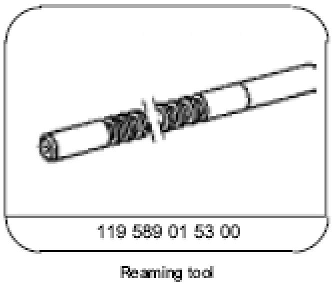


Fig. 109: Identifying Reaming Tool (119 589 01 53 00)



Fig. 110: Identifying Guide Sleeve (113 589 02 63 00)

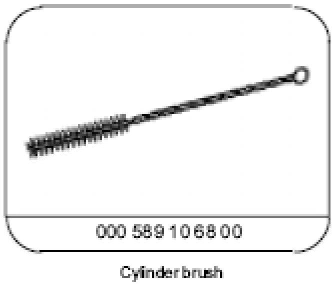


Fig. 111: Identifying Cylinder Brush (000 589 10 68 00)

1. Place cylinder head onto the supports (1). Align the supports so that the reaming tool is not able to strike the supports when it is pressed through.

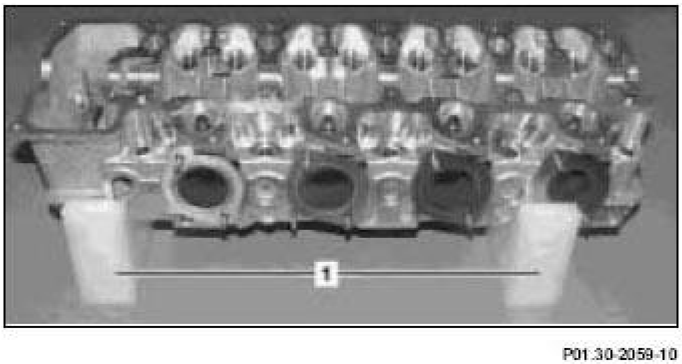


Fig. 112: Identifying Cylinder Head Supports

2. Insert reaming tool (2) into the basic bore.
3. Press reaming tool (2) through. Lubricate with petroleum during this step. Clean reaming tool (2) with compressed air or a plastic brush after each reaming operation. Use a matching aluminum drift as an extension in the area of the guide sleeve (3) for pressing through the reaming tool (2).

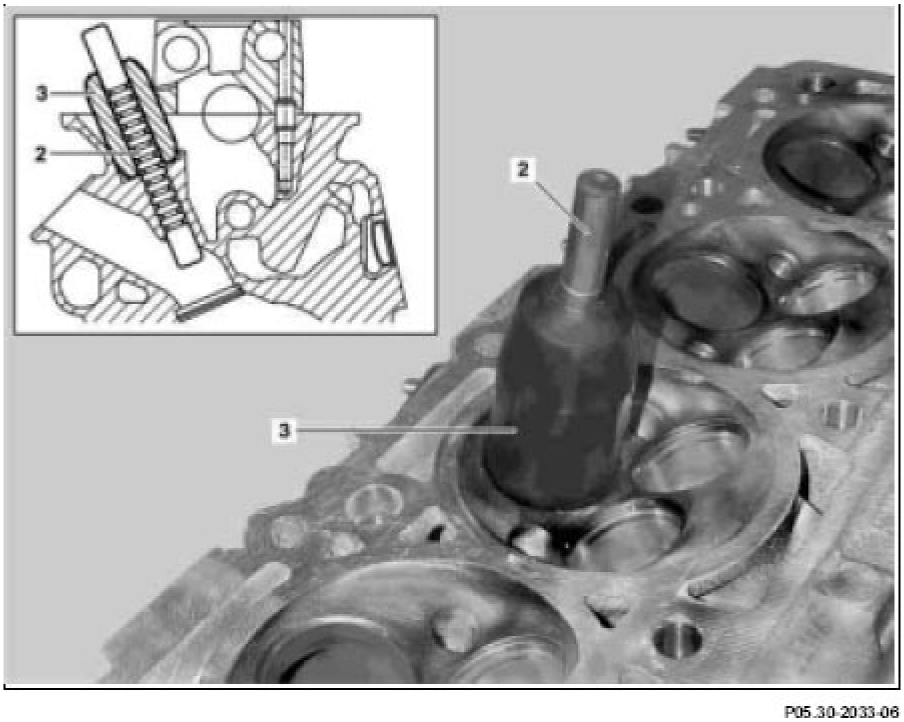


Fig. 113: Identifying Reaming Tool

INSPECT VALVE GUIDES - AR05.30-P-3731-06AV

Test and adjustment values for valve guides

Number	Designation			Engine 112 except 112.951/976, Engines 113.940/941/ 942/943/944/ 945/946/948/ 960/961/962/ 963/964/965/ 966/967/968/ 969/971/980/ 981/982/984/ 986/987/988/ 990/991/992/ 993/995	Engines 112.951/976
BE05.30-P-1001-02D	Outside diameter of exhaust and intake valve guide	Standard series	mm	12.540...12.551	12.540...12.551
		Standard I series (color: blue)	mm	12.560...12.571	12.560...12.571
		Repair stage I (color: red)	mm	12.740...12.751	12.740...12.751
		Repair stage II (color: yellow)	mm	13.140...13.151	13.140...13.151
BE05.30-P-1002-02D	Bore diameter in cylinder head of exhaust and intake valve guide	Standard series	mm	12.500...12.511	12.500...12.511
		Standard I series (color: blue)	mm	12.520...12.531	12.520...12.531
		Repair stage I (color: red)	mm	12.700...12.711	12.700...12.711
		Repair stage II (color: yellow)	mm	13.100...13.11113.100...13.1	13.100...13.11113.100...13.1
BE05.30-P-1003-02D	Overlap in cylinder head		mm	0.029...0.051	0.029...0.051
BE05.30-P-1004-02D	Length	L	mm	50	50
BE05.30-P-1005-02D	Dimension	A	mm	14.3 (±0.2)	14.3 (±0.2)

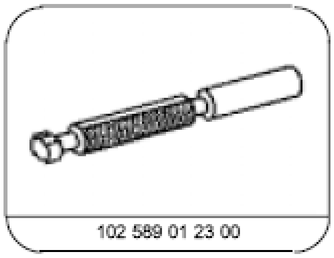


Fig. 114: Identifying Feeler (102 589 01 23 00)

1. Clean bore of valve guide (1) (never use a hard object).
2. Inspect surface of bore for scores or signs of rubbing. If damage to the surface is present, the valve guide must be replaced and the valve stem inspected for uneven areas. If the stem is damaged, the valve must be replaced together with the valve guide.

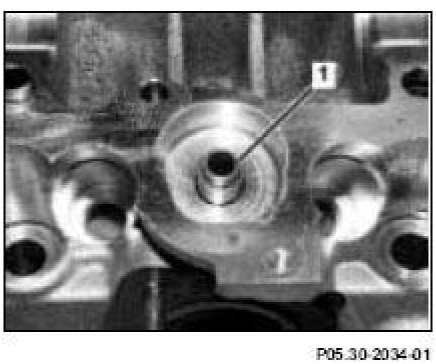


Fig. 115: Identifying Valve Guide

3. If it is possible to insert the side of the hole gauge (3) marked with "+220" over its full length (5 mm) into the valve guide, it is then necessary to replace the valve guide. Inspect bore of valve guide in longitudinal and transverse direction.

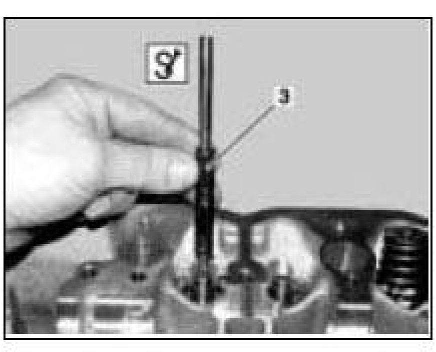


Fig. 116: Inserting Side Of Hole Gauge

CHECK, REMOVE, INSTALL VALVE GUIDES - AR05.30-P-3731AV

ENGINE 112

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243/246

ENGINE 113 in MODEL 129, 163, 202, 203, 208, 209, 210, 211, 215, 220, 230

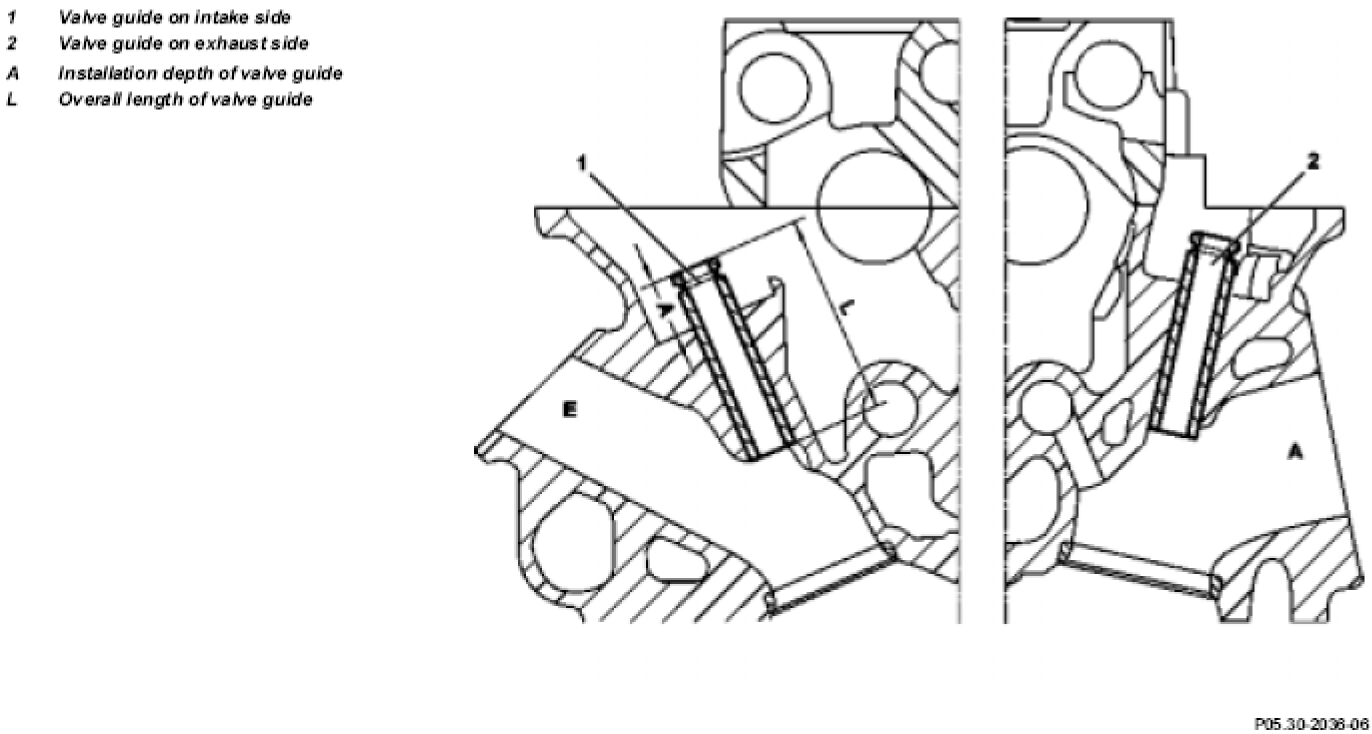


Fig. 117: Identifying Valve Guides

	Remove/install		
1	Remove valves	Engine 113 except 113.995 Engine 113.995	**AR05.30-P-3511AV** AR05.30-P-3511RVK
2	Inspect valve guides (1, 2)	 Installation depth of valve guide	**AR05.30-P-3731-06AV** ***BE05.30-P-1005-02D**
3	Knock out valve guides (1, 2)	The valve guides on the exhaust and intake sides are identical. Overall length of valve	**AR05.30-P-3731-01AV** ***BE05.30-P-1004-02D**

		guide	
4	Measure valve guide external diameter	Using an outside micrometer, measure and determine which valve guide was installed. Fit the next largest valve guide according to the valve guide installed.	***BE05.30-P-1001-02D**
			***WH58.30-Z-1002-12A**
		Valve guides of standard stage and standard stage I are not supplied as replacement parts; for this reason: ? Ream basic bore to repair stage I.	**AR05.30-P-3731-04AV** ***BE05.30-P-1002-02D** ***BE05.30-P-1003-02D**
5	Insert valve guides (1, 2), inspect		**AR05.30-P-3731-03AV**
6	Install in the reverse order		

Test and adjustment values for valve guides

Number	**Designation**			**Engine 112 except 112.951/976, Engines 113.940/941/ 942/943/944/ 945/946/948/ 960/961/962/ 963/964/965/ 966/967/968/ 969/971/980/ 981/982/984/ 986/987/988/ 990/991/992/ 993/995**	**Engines 112.951/976**
BE05.30-P-1001-02D	Outside diameter of exhaust and intake valve guide	Standard series	mm	12.540...12.551	12.540...12.551
		Standard I series (color: blue)	mm	12.560...12.571	12.560...12.571
		Repair stage I (color: red)	mm	12.740...12.751	12.740...12.751

		Repair stage II (color: yellow)	mm	13.140...13.151	13.140...13.151
BE05.30-P-1002-02D	Bore diameter in cylinder head of exhaust and intake valve guide	Standard series	mm	12.500...12.511	12.500...12.511
		Standard I series (color: blue)	mm	12.520...12.531	12.520...12.531
		Repair stage I (color: red)	mm	12.700...12.711	12.700...12.711
		Repair stage II (color: yellow)	mm	13.100...13.11113.100...13.1	13.100...13.11113.100...13.1
BE05.30-P-1003-02D	Overlap in cylinder head		mm	0.029...0.051	0.029...0.051
BE05.30-P-1004-02D	Length	L	mm	50	50
BE05.30-P-1005-02D	Dimension	A	mm	14.3 (±0.2)	14.3 (±0.2)

Commercially available tools

Number	Designation
WH58.30-Z-1002-12A	Micrometer

INSPECTION AND MACHINING DIMENSIONS OF VALVE SEAT RINGS - AR05.30-P-3831-03AV

Modification notes

23.6.04	BE05.30-P-1009-03C taken away		

Test values for valve seat rings

Number	Designation			Engine 112.910/911	Engine 112.912/914/915/920/921/922/923/940/941/942/943/944/945/946/947/948/951/960/961, 113.940/941/942/943/944
BE05.30-P-	Intake valve seat ring outer-	Standard	mm	31.1 (+0.015)	37.1 (+0.015)

1001-03C	ø		Rep. size 1	mm	32, 1	38, 3
BE05.30-P-1002-03C	Exhaust valve seat ring outer-ø		Standard	mm	35.1 (-0.01)	42.1 (-0.01)
			Rep. size 1	mm	36,3	43,3
BE05.30-P-1003-03C	Height of valve seat ring	Intake	Standard	mm	5.9 (-0.08)	5.9 (-0.08)
			Rep. size 1	mm	5.9 (-0.08)	5.9 (-0.08)
		Exhaust	Standard	mm	7.9 (-0.08)	7.9 (-0.08)
			Rep. size 1	mm	7.9 (-0.08)	7.9 (-0.08)
BE05.30-P-1004-03C	Valve seat ring - overlap in cylinder head		Intake	mm	0.084...0.115	0.084...0.115
			Exhaust	mm	0.074...0.100	0.074...0.100
BE05.30-P-1005-03C	Distance between contact face of cylinder head and end face of valve seat ring		Intake	mm	6.86...6.94	8.22...8.30
			Exhaust	mm	9.72...9.80	9.12...9.20
BE05.30-P-1006-03C	Basic bore diameter of inlet valve seat rings in cylinder head		Standard	mm	31.000...31.016	37.000...37.016
			Rep. size 1	mm	32.000...32.016	38.200...38.216
BE05.30-P-1007-03C	Basic bore diameter of exhaust valve seat rings in cylinder head		Standard	mm	35.000...35.016	42.000...42.016
			Rep. size 1	mm	36.200...36.216	43.200...43.216
BE05.30-P-1008-03C	Bore depth of valve seat rings in cylinder head	Intake	Standard	mm	12,76	14,12
		Exhaust	Standard	mm	17,62	17,02

Test values for valve seat rings

Number	**Designation**				**Engine 113.960/ 961/962/963/ 964/965/967/ 968/971/980/ 981/982/984/ 987/988/990/ 991/992/993/ 995**	**Engine 137.970**
BE05.30-P-1001-03C	Intake valve seat ring outer-ø		Standard	mm	39.1 (+0.015)	34,1
			Rep. size 1	mm	40,3	35,3
BE05.30-P-1002-03C	Exhaust valve seat ring outer-ø		Standard	mm	44.1 (-0.01)	37,1
			Rep. size 1	mm	45,3	38,3
BE05.30-P-1003-03C	Height of valve seat ring	Intake	Standard	mm	5.9 (-0.08)	5.9 (-0.08)
			Rep. size 1	mm	5.9 (-0.08)	5.9 (-0.08)
		Exhaust	Standard	mm	7.9 (-0.08)	5.9 (-0.08)
			Rep. size 1	mm	7.9 (-0.08)	5.9 (-0.08)
BE05.30-P-1004-03C	Valve seat ring - overlap in cylinder head		Intake	mm	0.084...0.115	0.084...0.115
			Exhaust	mm	0.074...0.0100	0.074...0.0100

BE05.30-P-1005-03C	Distance between contact face of cylinder head and end face of valve seat ring		Intake	mm	8.50...8.58	8.16...8.36
			Exhaust	mm	9.57...9.65	7.99...8.19
BE05.30-P-1006-03C	Basic bore diameter of inlet valve seat rings in cylinder head		Standard	mm	39.000...39.016	34.000...34.016
			Rep. size 1	mm	40.200...40.216	35.200...35.216
BE05.30-P-1007-03C	Basic bore diameter of exhaust valve seat rings in cylinder head		Standard	mm	44.000...44.016	37.000...37.016
			Rep. size 1	mm	45.200...45.216	38.200...38.216
BE05.30-P-1008-03C	Bore depth of valve seat rings in cylinder head	Intake	Standard	mm	14,40	13,99
		Exhaust	Standard	mm	17,47	14,16

Shown on exhaust valve seat ring

A *Height of valve seat ring*
B *Outer diameter of valve seat ring*
C *Bore depth of valve seat rings in cylinder head*
D *Distance between contact face of cylinder head and end face of valve seat ring*

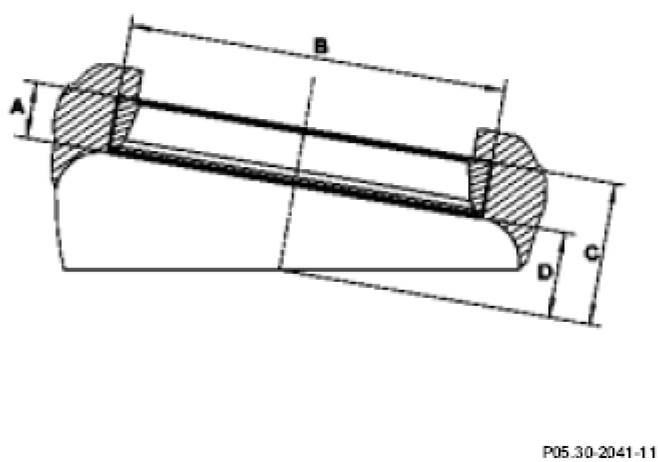


Fig. 118: Identifying Dimension - Shown On Exhaust Valve Seat Ring

Shown on exhaust side

E Basic bore diameter of the valve seat ring in the cylinder head

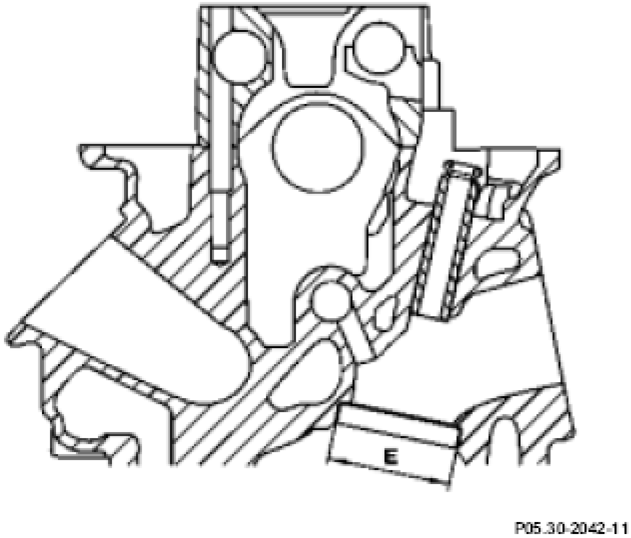


Fig. 119: Identifying Basic Bore Diameter Of Valve Seat Ring In Cylinder Head - Shown On Exhaust Side



The overlap of the valve seat ring in the cylinder head is determined as follows: outside diameter of the valve seat ring (B) minus the basic bore diameter of the valve seat ring in the cylinder head (E).

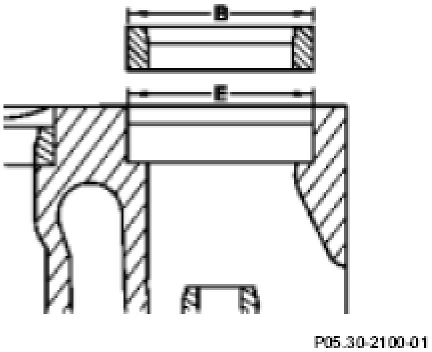


Fig. 120: Identifying Outside Diameter Of Valve Seat Ring And Basic Bore Diameter Of Valve Seat Ring In Cylinder Head

REPLACE VALVE SEAT RINGS - AR05.30-P-3831AV

ENGINE 112

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243/246

ENGINE 113 in MODELS 129, 163, 202, 203, 208, 209, 210, 211, 215, 220, 230

D1 Basic bore of valve seat ring (intake)

D2 Basic bore of valve seat ring (exhaust)

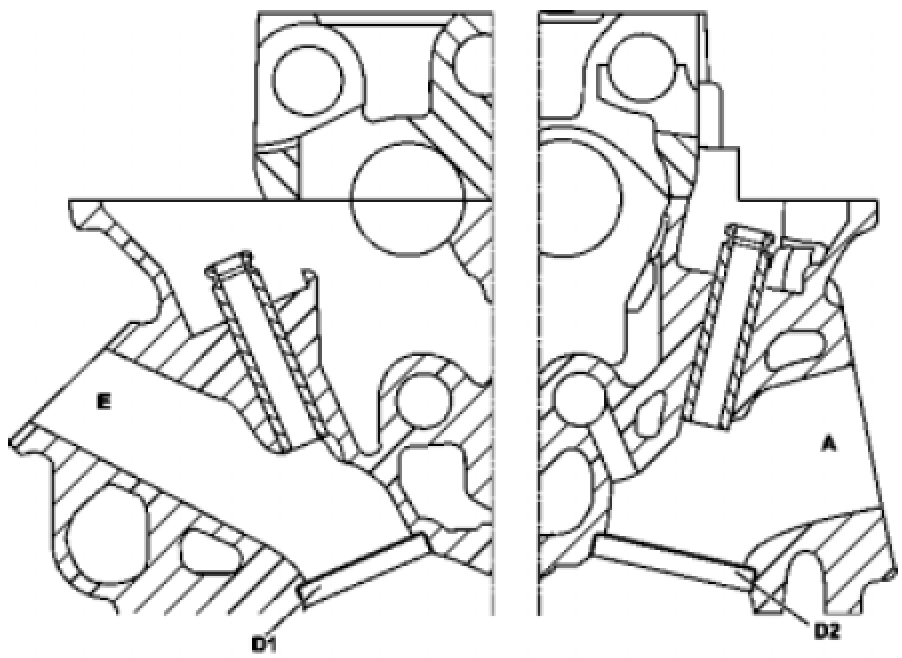


Fig. 121: Identifying Basic Bore Of Valve Seat Ring (Intake) And Basic Bore Of Valve Seat Ring (Exhaust)

Modification notes

25.2.04	**Value changed from 0.084...0.110 mm to 0.074...0.1 mm**	**Figure in BE05.30-P-1004-03C for engine 112.910/911 modified**	***BE05.30-P-1004-03C**
25.2.04	Value changed from 0.084...0.110 mm to 0.074...0.1 mm	Figure revised in BE05.30-P-1004-03C in case of engine 112.912/914/915/920/921/922/923/940/941/942/943/944/945/946/947/948/960/961, 113.940/941/942/943/944	***BE05.30-P-1004-03C**
25.2.04	Value changed from 0.084...0.110 mm to 0.074...0.1 mm	Figure revised in BE05.30-P-1004-03C in case of engine 113.960/961/962/963/965/967/968/980/981/982/984/987/988/990/991 /992	***BE05.30-P-1004-03C**

i	Remove/install		
1	Remove valves		**AR05.30-P-3511AV**
2	Inspect valve guide inner diameter for wear	If the measurements obtained for the valve guide are not within the specified tolerance ?	**AR05.30-P-3731-06AV**

		Replace valve guide.	AR05.30-P-3731AV
3	Turn valve seat ring out of the cylinder head with ring seat turning tool	Pay attention to operating instructions of ring seat turning tool. USA USA	 *WE58.40-Z-1009-21A *WE58.40-Z-1010-21A
4	Measure diameter of valve seat ring basic bore (D1, D2) in the cylinder head	Overlap between valve seat ring and basic bore must be assured. If the measurements obtained deviate from the test values: ? machine basic bores to the next oversize of the valve seat rings Pay attention to inspection and machining dimensions of the valve seat rings and of the basic bore ? Inspection and machining dimensions of valve seat rings	*BE05.30-P-1006-03C *BE05.30-P-1007-03C *BE05.30-P-1004-03C AR05.30-P-3831-03AV
Nm	**Risk of injury** to skin and eyes caused by handling hot or glowing objects.	Wear safety gloves, protective clothing and safety glasses, if necessary.	AS00.00-Z-0002-01A
5	Heat cylinder head in recirculated heating cabinet or heating oven	Temperature approx. 80 °C USA USA	 *WH58.30-Z-1001-28A *WH58.30-Z-1003-28A
8	Drive in valve seat ring using a suitable drift		
9	Machine valve seat rings	**After installing a new valve seat ring, the valve must always be replaced.**	AR05.30-P-4511AV
10	Install in the reverse order		

Test values for valve seat rings

Number	Designation	Engine 112.910/ 911	Engine 112.912/ 914/915/920/ 921/922/923/ 940/941/942/ 943/944/945/

					946/947/948/ 951/960/961, 113.940/941/942/943/944
BE05.30-P-1004-03C	Valve seat ring - overlap in cylinder head	Intake	mm	0.084...0.115	0.084...0.115
		Exhaust	mm	0.074...0.100	0.074...0.100
BE05.30-P-1006-03C	Basic bore diameter of inlet valve seat rings in cylinder head	Standard	mm	31.000...31.016	37.000...37.016
		Rep. size 1	mm	32.000...32.016	38.200...38.216
BE05.30-P-1007-03C	Basic bore diameter of exhaust valve seat rings in cylinder head	Standard	mm	35.000... 35.016	42.000... 42.016
		Rep. size 1	mm	36.200...36.216	43.200...43.216

Test values for valve seat rings

Number	**Designation**			**Engine 113.960/ 961/962/963/ 964/965/967/ 968/971/980/ 981/982/984/ 987/988/990/ 991/992/993/ 995**
BE05.30-P-1004-03C	Valve seat ring - overlap in cylinder head	Intake	mm	0.084...0.115
		Exhaust	mm	0.074...0.100
BE05.30-P-1006-03C	Basic bore diameter of inlet valve seat rings in cylinder head	Standard	mm	39.000...39.016
		Rep. size 1	mm	40.200...40.216
BE05.30-P-1007-03C	Basic bore diameter of exhaust valve seat rings in cylinder head	Standard	mm	44.000...44.016
		Rep. size 1	mm	45.200...45.216

Commercially available tools

Number	**Designation**
WH58.30-Z-1001-28A	Recirculated air warming cabinet
WH58.30-Z-1003-28A	Heating oven

Workshop equipment

WE58.40-Z-1009-21A	**Valve seat turning device**
WE58.40-Z-1010-21A	Valve seat turning device

MEASURE VALVE SETBACK TO CYLINDER HEAD - AR05.30-P-4100-01AV

Modification notes

25.3.04	Value changed from 8.50...8.90 mm to 8.05...8.45 mm	Value in series 1001, exhaust valve, for engine 113.962/982/987/990/991/993 changed
25.3.04	Value changed from 7.90...8.30 mm to 7.20...7.60 mm	Value in series 1001, intake valve, for engine 113.962/982/987/990/991/993 changed

Test and adjustment values of cylinder head

Number	Designation			Engines 112, 113.940/941/942/943/944/945/946/948 except 112.976	Engine 112.976
BE01.30-P-1001-02D	Valve setback of new valves and new valve seat rings	Exhaust valve	mm	8.05...8.45	8.50...8.90
		Intake valve	mm	7.60...8.00	7.90...8.30

Test and adjustment values of cylinder head

Number	Designation			Engine 113.960/961/963/965/966/967/968/980/981/984/986/992/995	Engine 113.987/988/989/990/991/993
BE01.30-P-1001-02D	Valve setback of new valves and new valve seat rings	Exhaust valve	mm	8.5...8.9	8.05...8.45
		Intake valve	mm	7.90...8.30	7.20...7.60

Workshop equipment

WE58.40-Z-1002-19A	Depth gage

Shown on engine 606

1. Measure valve setback (a) with depth caliper gage.

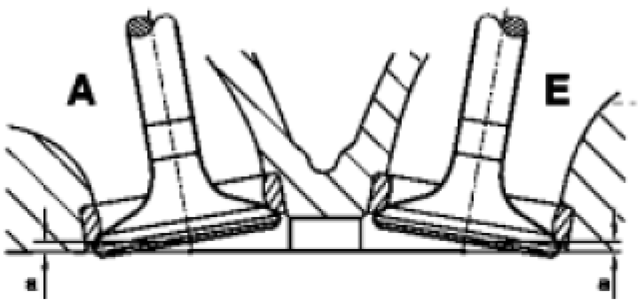


Fig. 122: Identifying Valve Setback - Shown On Engine 606

CHECK VALVES - AR05.30-P-4201-01AV

Modification notes

19.11.04	Value changed from 45 (±15') mm to 45 (+15') mm	Figure for series 1003 for engine 112 complete	***BE05.30-P-1003-01E**

Test values for valves

Number	Designation			Engine 112.910/911	Engine 112.912/913/914/915/920/921/922/923/940/941/942/943/944/945/946/947/948/949/960	Engine 112.951
BE05.30-P-1001-01E	Valve disk dia.	Exhaust	mm	34±0,1	41±0,1	41 ±0,1
		Intake	mm	30±0,1	36±0,1	36±0,1
BE05.30-P-1002-01E	Valve disk height	Exhaust when new	mm	1.6	1.6	1.6
		Intake valve when new	mm	1.2	1.2	1.2
BE05.30-P-1003-01E	Valve seat angle (a)	Exhaust	Angle°	45 (+15')	45 (+15')	45 (+15')
		Intake	Angle°	45 (+15')	45 (+15')	45 (+15')
BE05.30-P-1004-01E	Valve stem dia.	Exhaust	mm	6,970	6,970	6.970 (-0.02)
		Intake	mm	6,975	6,975	6.975 (-0.015)
BE05.30-P-1005-01E	Valve length	Exhaust	mm	121,65±0,2	122,25±0,2	122,25 (±0,2)
		Intake	mm	120,70±0,2	119,40±0,2	119,40 (±0,2)

Test values for valves

Number	Designation	Engines 113.940/941/942/943/944	Engine 113.960/961/962/963/	Engine 137.970

					965/967/968/ 980/981/982/ 984/987/988/ 990/991/992/ 993/995	
BE05.30-P-1001-01E	Valve disk dia.	Exhaust	mm	41±0,1	43±0,1	36±0,1
		Intake	mm	36±0,1	38±0,1	33±0,1
BE05.30-P-1002-01E	Valve disk height	Exhaust when new	mm	1.6	1.6	1.6
		Intake valve when new	mm	1.2	1.2	1.1
BE05.30-P-1003-01E	Valve seat angle	(aExhaust)	Angle°	45±15'	45±15'	45±15'
		Intake	Angle°	45±15'	45±15'	45±15'
BE05.30-P-1004-01E	Valve stem dia.	Exhaust	mm	6,970	6,970	6,970
		Intake	mm	6,975	6,975	5,975
BE05.30-P-1005-01E	Valve length	Exhaust	mm	122,25±0,2	121,80±0,2	104,30 ±0,2
		Intake	mm	119,40±0,2	119,10±0,2	103,60 ±0,2

A Valve shank diameter
B Valve length
C Valve disk height
D Valve disk diameter
α Valve seat angle

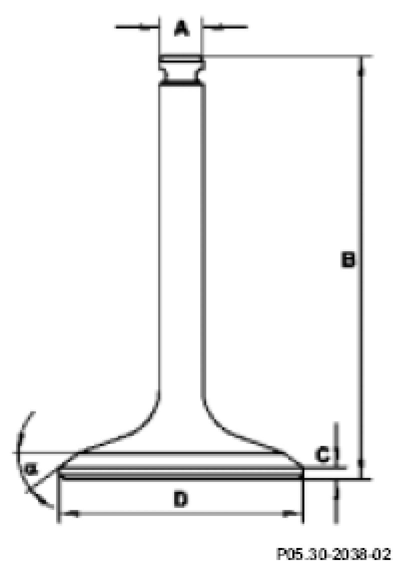


Fig. 123: Identifying Valve Dimensions

CHECKING AND MACHINING DIMENSIONS FOR VALVE SEATS - AR05.30-P-4510-01AV

Test values for valve seat rings

Number	**Designation**	**Engine 112.910/ 911**	**Engine 112.912/ 914/915/920/ 921/922/923/ 940/941/942/ 943/944/945/**

					946/947/948/ 951/960/961, 113.940/941/942/943/944
BE05.30-P-1009-03C	Inlet valve/exhaust valve valve seat	Width	mm	0.8...1.2	0.8...1.2
		Angle (a)	Angle°	45(+ 30')	45(+ 30')
		Correction Angle (ß)	Angle°	35 (±15')	35 (±15')
		Correction Angle (gamma)	Angle°	58 (±15')	58 (±15')

Test values for valve seat rings

Number	**Designation**			**Engine 113.960/ 961/962/963/ 964/965/967/ 968/971/980/ 981/982/984/ 987/988/990/ 991/992/993/ 995**	**Engine 137.970**
BE05.30-P-1009-03C	Inlet valve/exhaust valve valve seat	Width	mm	0.60...0.65	0.75...0.95
		Angle (a)	Angle°	45 (30')	45 (30')
		Correction Angle (ß)	Angle°	35 (±15')	35 (±15')
		Correction Angle (gamma)	Angle°	58 (±15')	58 (±15')

Shown at exhaust valve seat ring

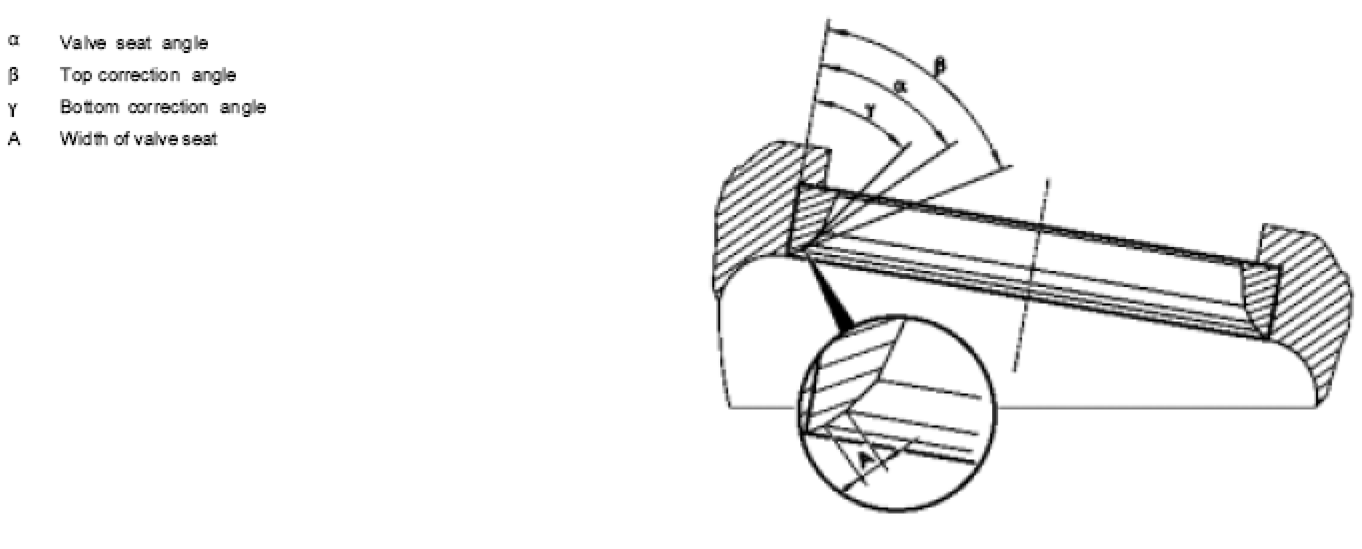


Fig. 124: Identifying Valve Seat Dimensions - Shown At Exhaust Valve Seat Ring

INSPECTING, REMOVING, INSTALLING VALVE GUIDES - AR05.30-P-4511AV

ENGINE 112

ENGINE 112.945 in MODEL 463.209 /232 /233 /244 /245 /250

ENGINE 113.962 in MODEL 463.206 /240 /241 /247 /248 /249 /254

ENGINE 113.982 in MODEL 463.243/246

ENGINE 113 in MODEL 129, 163, 202, 203, 208, 209, 210, 211, 215, 220, 230

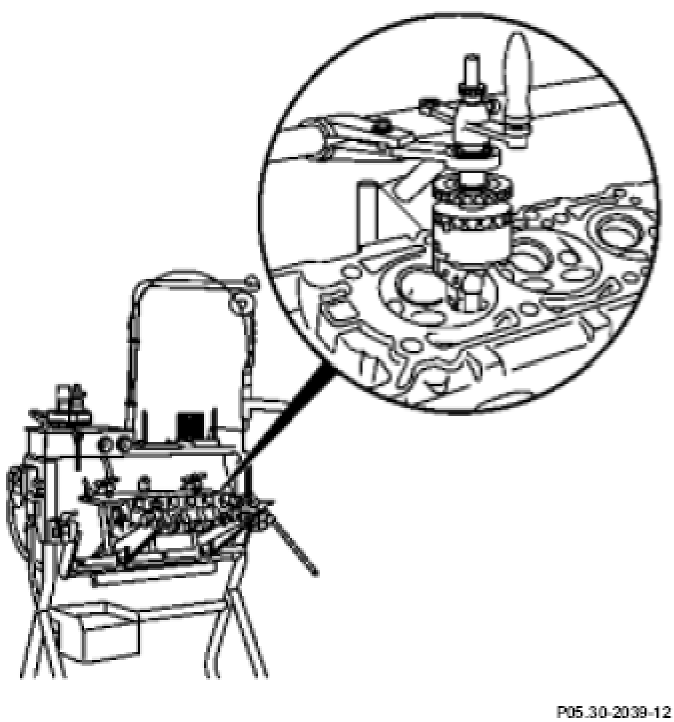


Fig. 125: Removing/Installing Valve Guides

	Remove		
1	Remove valves		**AR05.30-P-3511AV**
	Inspection		
2	Inspect valve guide,	Inspect valve guide if the measurements obtained are not within the stated tolerances ? Replace valve guide.	**AR05.30-P-3731-06AV** **AR05.30-P-3731AV**
	Machining		

3	Machin valve seat ring in cylinder head	USA USA Observe tool manufacturer's operating instructions, maintain dimensions in accordance with checking and machining dimensions. ? Checking and machining dimensions for valve seats If the measurements after machining are less than the specification ? Replace valve seat ring.	***WE58.40-Z-1009-21A** ***WE58.40-Z-1010-21A** **AR05.30-P-4510-01AV** **AR05.30-P-3831AV**
	Inspection		
4	Measure seat width	Correct valve seat width if necessary.	**AR05.30-P-4510-01AV**
5	Insert valve and inspect for leaks	Grind valve with valve grinding compound before installation. USA	***WH58.30-Z-1020-13A**
6	Measure valve set-back to cylinder head	If measurement is less than minimum dimension no further correct valve clearance compensation is possible; replace valve seat ring or cylinder head ? Replace valve seat ring. ? **The valve must always be replaced after installing a new valve seat ring.**	**AR05.30-P-4100-01AV** **AR05.30-P-3831AV**
i	**Install**		
7	Install valves		**AR05.30-P-3511AV**

Commercially available tools

Number	**Designation**
WH58.30-Z-1020-13A	Vacuum testing unit

Workshop equipment

WE58.40-Z-1009-21A	Valve seat turning device
WE58.40-Z-1010-21A	Valve seat turning device